Printed on Thin Paper for Foreign Circulation.

MAR 11 1924

Engineering Library

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

Vol. CXXXVII.—No. 3557] LONDON: FRIDAY EVENING, FEBRUARY 29, 1924 [Price One Shilling By Inland Post 1s. 3d.

PUBLIC NOTICES

The Director-General, INDIA STORE DEPARTMENT, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES—

1. SCREW COUPLINGS Complete, High-tensile Steel.
2. TUBES, MILD STEEL, GALVANISED, for Steam.
3. MACHINE for BORING LOCOMOTIVE CYLINDERS, with Electric Motor for Driving.
4. TUBE FITTINGS, MALLEABLE IRON, GALVANISED.

Tenders due on the 11th March, 1924, for No. 1, and on the 21st March, 1924, for Nos. 2 to 4.
Tender forms obtainable from above. 5063

Assistant Engineers REQUIRED by the GOVERNMENT of CEYLON for Railway Construction, for two years' service, with possible extension. Salary, £800, rising to £960 a year by annual increments of £30. Should the selected candidate be less than 30, the commencing salary will be £500 per annum. Free quarters or an allowance in lieu. Free passage provided. Candidates, unmarried, preferably between the ages of 30 and 35, must be experienced Engineers, who have received good training and experience on a recognised European or American Railway. Must have a thorough knowledge of Surveying, Levelling, Estimating, Setting-out and Supervising all Works in connection with the Location and Construction of a Railway. Members or Associate Members of the Institution of Civil Engineers preferred.
Apply at once by letter, stating age and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/Ceylon 12,610. 5015

Assistant Engineer REQUIRED for the PUBLIC WORKS DEPARTMENT of the GOVERNMENT of the STRAITS SETTLEMENTS for three years' service with prospect of permanency. Salary 400 dollars a month, rising to 800 dollars a month by annual increments of 25 dollars a month, plus a temporary non-pensionable allowance of 10 per cent. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., and its purchasing power in Malaya is considerably less than that in the United Kingdom. Free passages provided. Candidates, age 25 to 35, unmarried, must be Associate Members of the Institution of Civil Engineers, and have had at least three years' practical experience (exclusive of appointment as Engineering Assistants under an Engineer who is a member of the Institution of Civil Engineers.—Apply at once by letter, giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/12,017. 5075

Assistant Locomotive SUPERINTENDENT REQUIRED for the NIGERIAN GOVERNMENT RAILWAY for one tour of from 12 to 18 months' service, with prospect of permanency. Salary, £480 a year for the first three years, then £510, rising by annual increments of £30 to £720, and thence by annual increments of £40 to £920. Outfit allowance of £60 on first appointment. Free quarters and 1st class passages, and liberal leave on full salary. Candidates, age 25 to 35, should be of good education and preferably possess an approved Engineering Diploma. They should have served an apprenticeship in the Locomotive Workshops of a British Railway, and have had experience on the Footplate and in Fitting, Turning and Erecting, and in the Patternshop, Foundry and Drawing-office. They MUST have had Running Experience and should be conversant with Running Shed Procedure and Breakdown Work.—Apply at once by letter, stating age and particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/Nig. 12,614. 5014

Immediate Vacancies in GOVERNMENT DEPARTMENTS; OPEN TO EX-SERVICE CANDIDATES ONLY.

TWO DRAUGHTSMEN for Heating Systems. Should have had sound technical education and some years' practical experience of the Design and Lay out of Heating and Pipe Installations of all kinds, including Steam and Hot Water. Should also be capable of preparing specifications, detailed drawings, and taking out quantities. Salaries according to qualifications and experience, but not exceeding £6 10s. per week.

TWO STEELWORK DRAUGHTSMEN. Candidates should have had sound theoretical training and some years' practical experience gained in the Drawing-office of a well-known firm in the Design and Calculation of Steel-framed Building Construction work. Salaries according to qualifications, but not exceeding £6 10s. per week.

The above posts are temporary, but are expected to last for not less than six months. Written applications, giving full details and qualifications and experience, should be addressed to the JOINT SUBSTITUTION BOARD (Treasury and Ministry of Labour), Montague House, Whitehall, S.W. 1. Replies will be sent only to such candidates as appear suitable for interview. 5062

The University of Oxford will shortly proceed to APPOINT a DIRECTOR of the INSTITUTE for RESEARCH in AGRICULTURAL ENGINEERING at a salary of £800. Forms of application may be obtained from the SECRETARY to the Committee for Rural Economy, by whom applications will be received till March 15th. 4985

Bethnal Green Board of GUARDIANS.
INSTALLATION OF MOTORS.

The Bethnal Green Board of Guardians invite TENDERS for the INSTALLATION of MOTORS and the WIRING therefor, in the Laundry at Waterloo House, Waterloo-road, Bethnal Green, E. 2.
Forms of Tender, with specification, will be supplied upon application being made to me, accompanied by a deposit of £3, which will be returned upon receipt of a bona fide Tender.
Sealed Tenders, endorsed "Laundry Motors," to be delivered at my office as undermentioned, not later than Twelve Noon on the 18th day of March, 1924.
The Guardians do not bind themselves to accept the lowest or any Tender.

By Order,
C. FAULKNER JONES,
Clerk to the Guardians.

Administrative Offices,
795, Bishop's-road, E. 2.
22nd February, 1924. 5035

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Irrigation Dam in the Transvaal.

Locomotive Boiler Performance—No. II.

The Repair and Upkeep of Pneumatic Tools.

Practical Hydraulic Engineering Problems.

The Cruiser Programme.

Treatment of Water for Industrial Purposes.

An Angle Compound Air Compressor.

Motor Machinery for Fire Floats.

Tamping and Concrete Breaking Machine.

PUBLIC NOTICES

Borough of Falmouth.

The Corporation of Falmouth are prepared to receive TENDERS for the LAYING of about 5600 Yards of CONCRETE TUBE, STONEWARE PIPE and CAST IRON PIPE SEWERS of 18in., 15in., 12in., 9in. and 7in. diameter, together with Manholes and other appurtenances. About 1150 yards of sewer will be in tunnel cut through rock.
Plans can be seen, and the specification, bill of quantities, form of Tender and draft contract obtained, at the Borough Surveyor's Office, Falmouth, or at the offices of the Engineer, Mr. C. Midgley Taylor, Messrs. John Taylor and Sons, 36, Victoria-street, Westminster, S.W. 1, on or after Wednesday, 5th March, 1924, upon payment of £5 5s. by cheque, which will be returned on receipt of a bona fide Tender on the form supplied.
As the works are for the relief of the unemployed, the contract will be subject to the special conditions laid down by the Unemployment Grants Committee, and the works must be in active progress by the first day of April, 1924.
Tenders, sealed and endorsed "Falmouth Sewerage, Contract No. 2," to be sent to the undersigned on or before Noon Wednesday, 19th March, 1924.
The Corporation will not be bound to accept the lowest or any Tender.

W. H. LUPTON,
Town Clerk.

Municipal Offices, Falmouth. 5084

County Borough of Middlesbrough.
DOCKS, &c., SCHEME.

The Corporation invite TENDERS for the CONSTRUCTION of DOCKS, WHARVES, LANDING-PLACES, &c., at the site of the Ferry, Middlesbrough.
Copies of conditions, specifications and form of Tender will be supplied on application to the undersigned, on payment of a deposit of Five Pounds, which will be returned on receipt of a bona fide Tender. The plans may be inspected at the office of Mr. A. C. Mitchell, M. Inst. C.E., Royal Exchange, Middlesbrough, where arrangements may also be made for loan of prints.
Sealed Tenders, on the forms and in the envelopes supplied, are to be delivered to the undersigned on or before first post on Monday, the 24th day of March next, and endorsed "Tender for Docks Scheme."
The Council do not bind themselves to accept the lowest or any Tender.
The scheme will be carried out as work for the relief of unemployment, and the Unemployment Grants Committee's conditions of grant will have to be complied with, which are fully set out in the general conditions.

PRESTON KITCHEN,
Town Clerk.

Municipal Buildings,
Middlesbrough.
25th February, 1924. 5060

Metropolitan Water Board.
SUPPLY OF SEMI-POSITIVE AND DIFFERENTIAL TYPE WATER METERS.

The Metropolitan Water Board invite TENDERS for the SUPPLY of 3in., 4in. and 6in. SEMI-POSITIVE and 4in. and 6in. INFERENTIAL (Siemens) TYPE WATER METERS, delivered to the Board's Works at Rosoman-street, Clerkenwell, E.C. 1.
Forms of Tender may be obtained from the Chief Engineer by personal application (Room 155), or upon forwarding a stamped addressed brief envelope.
Tenders must be made on the official form, and be addressed to the "Clerk of the Board, Metropolitan Water Board, New River Head, Rosebery-avenue, E.C. 1," endorsed "Tender for Water Meters," and must reach the Offices of the Board not later than 11 a.m. Friday, 7th March, 1924.
The Board do not bind themselves to accept the lowest or any Tender.

C. F. STRINGER,
Clerk of the Board.

Offices of the Board,
New River Head,
173, Rosebery-avenue, E.C. 1,
27th February, 1924. 5078

PUBLIC NOTICES

Hoylake and West Kirby.
THE URBAN DISTRICT COUNCIL OF HOYLAKE AND WEST KIRBY.
HOUSE REFUSE SCREENING PLANT.

The Council are prepared to receive TENDERS for the SUPPLY, DELIVERY, and ERECTION, in building provided, of:
Contract No. 1.—REVOLVING SCREEN or VIBRATORY CASCADE SCREEN.
Contract No. 2.—PICKING BELT.
Intending contractors may quote for either one or both of the above contracts.
Further particulars and forms of Tender may be obtained for the above upon written application to the Engineer and Surveyor to the Council, Town Hall, Hoylake.
Sealed Tenders, enclosed in the special envelope provided, and endorsed on the outside "Tender for ——," to be delivered through the post not later than Monday, the 24th day of March, 1924.
The Council do not bind themselves to accept the lowest or any Tender.

R. W. FRASER,
Engineer and Surveyor.

Town Hall, Hoylake,
27th February, 1924. 5077

State Electricity Commission OF VICTORIA.
MELBOURNE VICTORIA, AUSTRALIA.

TENDERS are HEREBY INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.
Copies of Tender form and specification will be available upon application to—
Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.
SPECIFICATION No. 24/7.—100,000-Volt TESTING TRANSFORMER.
CHARGE, 10s. for the first two copies of Tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A third copy and any further copies will be supplied for the sum of 5s. each. This charge is not returnable.
PRELIMINARY DEPOSIT.—A preliminary deposit of £5 is to be lodged with Tender.
The specifications may be inspected at the above mentioned offices.
The Commission does not bind itself to accept the lowest or any Tender.
Tenders close at the Commission's Office, Melbourne, on the 10th March, 1924, and prices should be cabled (cable address, Electrocom, Melbourne) to the Commission on or before that date, and Tenders on the prescribed form, properly endorsed and addressed, must be forwarded by the following mail to

R. LIDDELOW,
Secretary.

State Electricity Commission of Victoria,
Melbourne, Victoria, Australia. 4940

The Great Indian Peninsula RAILWAY COMPANY, 4a, Copthall-avenue, London, E.C. 2, invite TENDERS for—

1. MILD STEEL BARS, SECTIONS, &c.	Fee 10s.
2. FENCING MATERIALS	„ 5s.
3. CRANK AXLES (MACHINED) for LOCO. ENGINES	„ 10s.
4. SPARE PARTS of LOCOMOTIVE ENGINES	„ 7s. 6d.
5. TYRE-RETAINING RINGS	„ 5s.
6. AXLE-BOXES for CARRIAGES and WAGONS	„ 7s. 6d.
7. BOLTS, NUTS and RIVETS, &c.	„ 10s.
8. STEEL TYRES for LOCO. ENGINES and TENDERS	„ 10s.
9. STEEL TYRES for CARRIAGES and WAGONS	„ 10s.
10. LAMINATED SPRINGS	„ 10s.
11. GIBS and COTTERS	„ 5s.
12. CAST IRON CHAIRS	„ 7s. 6d.

Tenders are due by 11 a.m. on 11th March, 1924. Tender forms obtainable at above address. Fees not returnable. 5065

PUBLIC NOTICES

London and North-Eastern RAILWAY.

The Directors are prepared to receive TENDERS for the RENEWAL of the FLOOR of BRIDGE No. 18, carrying New Bridge-street, Newcastle, over the Newcastle and Berwick Railway at Newcastle-upon-Tyne. The contract comprises the Supply and Erection of Rolled Steel Beams (500 tons) embedded in Concrete, Concrete Road Bed, &c., but not the making of the road surfaces, tramways, drains, &c., which will be carried out by the Newcastle City Engineer. The contractor is also to remove and purchase the existing W.I. decking (400 tons).
Drawings and specifications may be seen and detailed quantities and form of Tender obtained on personal application at the Branch Office of the Chief Engineer, North-Eastern Area, at Forth Banks, Newcastle-upon-Tyne, on and after Thursday, February 28th. Tenders, marked "Tender for Renewal of Floor of Bridge No. 18, Newcastle and Berwick Railway," must be received by the Joint Secretaries, London and North-Eastern Railway, Marylebone Station, London, N.W. 1, by 9 a.m., Thursday, March 13th.
The Directors do not bind themselves to accept the lowest or any Tender.

JAMES McLAREN,
G. F. THURSFIELD,
Joint Secretaries.

Secretary's Office,
L.N.E. Rly., Marylebone Stn.,
25/2/24. 5056

West Bromwich Union.
TO BOILER MAKERS, ENGINEERS, BUILDERS, &c.

The Guardians invite TENDERS for the INSTALLATION of STEAM MAINS, EXHAUST PIPES and LOW-PRESSURE HEATING and HOT WATER SERVICES at the above Institution, in accordance with specifications and plans prepared by Messrs. Edwards and Shaw, Consulting Engineers, 105, Colmore-row, Birmingham.
Preference will be given to firms on the King's Roll.
Conditions of contract may be seen at the undermentioned address, and specification, plan and form of Tender will be supplied by me upon application being made accompanied by a deposit of £5 5s., between Monday, the 3rd, and Saturday, the 8th March, 1924. The amount deposited will be returned by cheque after the receipt of a bona fide Tender, sealed and endorsed "Tender for Steam Mains, Exhaust Pipes, &c., Hallam House," and forwarded so as to reach me not later than the first post on Friday, the 28th March, 1924.

By Order,
A. H. WARD,
Clerk.

22, Lombard-street, West Bromwich.
21st February, 1924. 5050

West Bromwich Union.
TO BOILERMAKERS, ENGINEERS, BUILDERS, &c.

The Guardians invite TENDERS for the following:
(1) The ERECTION of STEEL FRAMED BOILER-HOUSE, &c.;
(2) The SUPPLY of THREE LANCASHIRE BOILERS;
(3) The PROVISION of SEATING for THREE LANCASHIRE BOILERS;
(4) The PUTTING IN of CONCRETE FOUNDATION and BLOW-OFF PIT for Boiler-house;
at the above Institution, in accordance with specifications and plans prepared by Messrs. Edwards and Shaw, Consulting Engineers, 105, Colmore-row, Birmingham.
Preference will be given to firms on the King's Roll.
Conditions of contract may be seen at the undermentioned address, and specification, plan and form of Tender for either of the items will be supplied by me upon application being made accompanied by a deposit of £5 5s., between Monday, the 3rd and Saturday, the 8th March, 1924. The amount deposited will be returned by cheque after the receipt of a bona fide Tender, sealed and endorsed:
For Item (1)—"Tender for Boiler-house, Hallam House."
For Item (2)—"Tender for Boilers, Hallam House."
For Item (3)—"Tender for Seating for Boilers, Hallam House."
For Item (4)—"Tender for Concrete Foundation, &c., Hallam House,"
and forwarded so as to reach me not later than the first post on Friday, the 21st March, 1924.

By Order,
A. H. WARD,
Clerk.

22, Lombard-street, West Bromwich.
24th February, 1924. 5051

PUBLIC NOTICES (continued) Page 2.

"THE ENGINEER" WANTED.

WANTED, "THE ENGINEER," Bound or Unbound, from July, 1915, to June, 1921.—Address, stating lowest price, P1000, The Engineer Office. P1000

WANTED, "THE ENGINEER," Volumes January to June, 1909, and January to June, 1911; Single Copies dated May 17th, 1909 and May 16th, and 23rd, 1911.—Address lowest price and particulars to J. D. K. R., The Engineer Office. P1000

SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
PATENTS, Page 3.
PARTNERSHIPS, Page 2.
MACHINERY, &c., WANTED Page 3.
FOR SALE, Pages 3, 4 and 94.
AUCTIONS, Page 91.
PREMISES TO LET OR WANTED Page 3.
WORK WANTED, Page 4.
AGENCIES, Page 3.
MISCELLANEOUS, Page 2.

For Advertisement Rates see Page 229, Col 1.

NUMERICAL INDEX TO ADVERTISEMENTS Page 93.

PUBLIC NOTICES (continued)

Midland Great Western Rail-
WAY OF IRELAND COMPANY.
STEEL RAILS AND FISH PLATES.

The Directors of the above-named Company are prepared to receive TENDERS for the SUPPLY of 3500 Tons of STEEL RAILS and corresponding FISH PLATES.

Specification, giving all particulars, can be had on application to the undersigned.

Tenders, sealed and endorsed "Tender for Rails," to be forwarded, addressed to the Chairman, Midland Great Western Railway, Broadstone Terminus, Dublin, so as to reach him not later than Monday, 17th March, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

PERCY A. HAY,
Secretary.
Broadstone Terminus, Dublin,
25th February, 1924. 5035

Sale by Tender.—The Liquidator of the Variable Pumps and Motors, Limited (in Voluntary Liquidation) is prepared to receive TENDERS for the PURCHASE of the whole of the FOREIGN PATENTS relating to "Improvements in Pumps and other Similar Apparatus." The countries covered by these patents are Australia, Austria, Argentine, Belgium, Canada, Czecho-Slovakia, France Germany, Hungary, Holland, Italy, Japan, New Zealand, Poland, Spain, Switzerland, United States of America.

Forms of Tender may be obtained from Mr. M. LANCASTER, F.C.A., the Liquidator, at 46, Basinghall-street, London, E.C., to whom all Tenders must be sent not later than Twelve Noon on the 13th March, 1924. 5068

Department of Scientific and INDUSTRIAL RESEARCH.

An ASSISTANT ENGINEER is REQUIRED for the FUEL RESEARCH STATION, EAST GREENWICH, S.E.10. Scale of salary, £370-£20-£550, plus usual Civil Service bonus. Present commencing pay, £530 5s. Superannuation provision will be made under the Federated Superannuation System for Universities, under which a contribution of approximately 10 per cent. of salary is paid by the Department and 5 per cent. is paid by the officer.

Candidates should be fully qualified Engineers, with Electric Power Station Experience. Research Experience is desirable. Preference will be given, other things being equal, to ex-Service men.

Applications, giving particulars of age, qualifications, military, &c., with copies of testimonials and/or names of referees, should be made in writing, not later than 17th March, to the SECRETARY, Department of Scientific and Industrial Research, 16, Old Queen Street, S.W.1. 5048

Port of London Authority.
APPLICATIONS are INVITED for the POSITION of MECHANICAL ENGINEER.

Candidates must not exceed 45 years of age, and must be fully qualified Members of the Institution of Mechanical Engineers, with wide experience in the Design, Construction, Maintenance and Running of the Mechanical Equipment of Docks and Harbours, including Electrical and Hydraulic Installations, Pumping, Refrigerating and Grain-discharging Machinery, Cranes, Conveyors, Locomotives, Lock-gate Machinery and Bridges, &c.

Applications, giving particulars of experience, qualifications, &c., and stating salary required, must be on the prescribed form, obtainable from the Staff Manager, Port of London Authority, E.C. 3, and be delivered not later than the 31st March, 1924.

Any canvassing of Members of the Authority by or on behalf of an applicant will entail the application being ignored.

F. AYLIFFE,
4920 Secretary.

Port of London Authority.
APPLICATIONS are INVITED for the POSITION of CHIEF DRAUGHTSMAN.

Candidates must not exceed 45 years of age and must be capable of Organising and Controlling the Staff of a large Drawing-office. They must have had thorough experience in the Design of Bridges, Caissons, Gates and Dock Entrances, and General Dock and Railway Construction and Equipment Work, and also experience in the Preparation of Charts, Reductions and Enlargements.

Applications, giving particulars of experience, qualifications, &c., and stating salary required, must be on the prescribed form obtainable from the Staff Manager, Port of London Authority, E.C. 3, and be delivered not later than the 31st March, 1924.

Any canvassing of members of the Authority by or on behalf of an applicant will entail the application being ignored.

F. AYLIFFE,
4919 Secretary.

SITUATIONS OPEN

ADVERTISERS, Box 4882, ACKNOWLEDGE APPLICATIONS, with thanks; POSITION NOW FILLED. 5022 A

WANTED, a First-class MAN, Used to Control of Cold Press Plant for Production of Pressings for Motor Trade; able to organise production and supervise men. Good position for the right man, who must have had first-class experience and able to produce on economic lines.—Address, 5016, The Engineer Office. 5016 A

WANTED, AGENT ENGINEER for Westminster Contractors; preferably with experience of Underground Work.—Address, stating age, qualifications and salary required, 5069, The Engineer Office. 5069 A

WANTED by Civil Engineer, Westminster, TWO capable DRAUGHTSMEN, having experience in the Design of Water and other Public Works; good education, not more than 35; one having Architectural training and the other knowledge of General Engineering Design. State experience and salary required. —Box 1768, c.o. Brown's, 29, Tothill-street, S.W.1. 5025 A

WANTED by a Firm of Consulting Engineers, an ASSISTANT ENGINEER; good theoretical and practical knowledge of the Steam Side of Modern Power Stations essential; age preferably between 30 and 35.—Applications, stating age, whether married or single, salary required, full particulars of experience and giving two or more references, should be addressed to 5019, The Engineer Office. 5019 A

ASSOCIATED BRITISH MACHINE TOOL MAKERS, Limited
17, GROSVENOR GARDENS, S.W.1.

WANTED, MANAGER for Manchester District Office, with Technical and Commercial experience. And, for the Birmingham District, REPRESENTATIVE, with expert knowledge of Machine Tools.

Also, for their London Office, an ASSISTANT SECRETARY, experience in Accountancy essential and a knowledge of Foreign Trade and Languages desirable.

Apply by letter, addressed to the CHAIRMAN (which will be treated as strictly confidential), stating age, experience and salary required. 5038 A

WANTED, Thoroughly Experienced and Energetic YOUNG MAN as ASSISTANT WORKS MANAGER for large Rolling Stock Works in Yorkshire; excellent opportunity for the right man.—Address, stating age, experience and salary required, 5074, The Engineer Office. 5074 A

WANTED, TRAVELLING SALESMAN for Woodworking Machinery for Birmingham district; also for Manchester district. Intimate knowledge of Wood-working Machinery essential.—Address in first place, 5017, The Engineer Office. 5017 A

AUTOGENOUS TOOLS.—London Office of Continental Makers REQUIRE capable OFFICE MANAGER to Organise British and Colonial Business. State age, details of previous experience, and salary required. Knowledge of Autogenous Tools essential.—Write, "H. E.," E.O. Street's, 6, Gracechurch-street, E.C. 3. 5040 A

SITUATIONS OPEN (continued)

AN Old-established FIRM of HEATING and DOMESTIC ENGINEERS will PAY liberal COMMISSION to REPRESENTATIVE who can introduce business or furnish information of pending works. Permanent situation with good salary for a thoroughly competent man with a genuine knowledge, or partnership could be arranged.—Write, Box 399, Samson Clark and Co., Ltd., 57, Mortimer-street, London, W.1. 5015 A

ASSISTANT ENGINEER, with Training in Theoretical Side of Mechanical and Electrical Engineering and with Shop experience, REQUIRED for large works in Midlands; age 30 to 35 years; wages £5 per week.—Address, 5073, The Engineer Office. 5073 A

CHARTERED PATENT AGENT REQUIRES ASSISTANT.—Write, stating age, experience, and any special qualifications, to L. A. REDDIE, 1, Furnival street, Holborn, E.C. 4. 5032 A

ENGINEER WANTED by Company Manufacturing well-known apparatus for Steam Boilers; salary £300 to commence. Must invest £500 at least. Full particulars will be supplied suitable applicant, who must send all information of experience, &c., in first letter.—Address, 5059, The Engineer Office. 5059 A

FIRST-CLASS PLANNING ENGINEER for Controlling Operations on Instrument Components; must be good organiser and hold similar position before.—Address, giving age and salary req'd., P8709, The Engineer Office. P8709 A

JUNIOR SHORTHAND TYPIST REQUIRED for Engineer's Office; knowledge of Electrical Work required.—Address, P8753, The Engineer Office. P8753 A

MANUFACTURING ENGINEERS REQUIRE CLERK (28-30), City office, for Orders, Stock, Costs, Shipping, Shorthand Typing and D.E. Books Supervision; similar experience necessary. Quick, reliable, accurate worker will advance.—Address, own handwriting, state salary, references, when free, &c., 5080, The Engineer Office. 5080 A

OUTSIDE REPRESENTATIVE REQUIRED by well-known firm of Heating Engineers to call on architects and consulting engineers.—Address, stating age, experience and salary required, P8752, The Engineer Office. P8752 A

REINFORCED CONCRETE ENGINEERS are OPEN to ENGAGE a competent DESIGNER, with good working knowledge of the theory of Elasticity applied to Frames; experience in Detailing Reinforced Concrete Structures essential.—Address, giving full particulars of experience, technical training, age and salary required, P8754, The Engineer Office. P8754 A

REQUIRED by a Public Company for Work in Great Britain, an ASSISTANT ENGINEER for DREDGING, who must have had considerable experience in the Working and Maintenance of Bucket Dredgers and Attendant Craft, the control of men, also taking and plotting soundings. Applicants should state age, when disengaged, salary required, previous experience and positions held chronologically with dates, and should include copies of any recent testimonials.—Address, 5023, The Engineer Office. 5023 A

TO COMBUSTION ENGINEERS AND FUEL ECONOMY EXPERTS.—Important new Company REQUIRES a RESIDENT BRANCH MANAGER in each of the following centres, to Inspect, Advise, and Report on Clients' Plants:—Sheffield, London, Birmingham, Cardiff, Newcastle-on-Tyne, and Liverpool. Commencing salary, £300, plus commission and £100 ord. shares; moderate investment required. Full particulars.—Address, 5036, The Engineer Office. 5036 A

WORKS MANAGER.—Midland FIRM of ENGINEERS WISH to APPOINT ASSISTANT or UNDERSTUDY to WORKS MANAGER. Selected applicant must be a trained Engineer, having served apprenticeship with reputable firm, and possess proofs of thorough knowledge of Theory and Principles of General Engineering. Previous Executive Experience is desirable. Energy, initiative, inventiveness, enthusiasm for efficiency and broad view in labour problems are essential qualities. Fullest particulars.—Address, 4976, The Engineer Office. 4976 A

WANTED by Large Engineering Works in the North of England, ASSISTANT CHIEF DRAUGHTSMAN and DRAUGHTSMEN with thorough theoretical training and extensive experience in the Design and Detail of all classes of Bridges, Dock Machinery (Hydraulic and Electric), Dock Gates, Caissons and Cranes.—Address, with full particulars of training and experience, 5039, The Engineer Office. 5039 A

WANTED, Competent DRAUGHTSMAN. Age about 25 or 27, with experience in Turret Lathes and other Machine Tools. State experience and salary required.—Address, 5044, The Engineer Office. 5044 A

WANTED for Engineering Works, North London, first-class DESIGNER for Electrical and Light Mechanical Apparatus.—Address, stating full particulars, 5082, The Engineer Office. 5082 A

WANTED for London Office of Engineers, a MECHANICAL DRAUGHTSMAN, conversant with Structural Steelwork, Conveying and Screening Plant, Gearing, Shafting, &c. State age, salary and references.—Address, P8745, The Engineer Office. P8745 A

WANTED IMMEDIATELY, SEVERAL SENIOR and JUNIOR DRAUGHTSMEN for Water-tube Boiler Work. None but competent men need apply. Please state age, salary required, particulars of experience, and when at liberty.—Address, 4908, The Engineer Office. 4908 A

WANTED, SENIOR DRAUGHTSMAN, with First-class experience in the Design of Aero-engines and high-class Motor Cars, for an office in London. —Address, giving full particulars of past experience and salary required, 5020, The Engineer Office. 5020 A

WANTED, STRUCTURAL DRAUGHTSMAN for Firm in South Wales; must have first-class experience in Design and Detail of Workshop Buildings, Crane Gantries and General Constructional Steelwork. State age, experience and salary required.—Address, 5076, The Engineer Office. 5076 A

DRAUGHTSMAN, CONSTRUCTIONAL, for London, able to Design and Carry Through Work.—Address, age, salary and experience to P8628, The Engineer Office. P8628 A

DRAUGHTSMEN (DESIGNERS) REQUIRED by leading firm of Reinforced Concrete Specialists. Must have had experience in the Design of Reinforced Concrete Work, and be good Draughtsmen.—Address, in confidence, stating age, salary required, and full details of experience, 5058, The Engineer Office. 5058 A

DRAUGHTSMAN REQUIRED for Engineer's London Office, skilled in Preparing Lay-out Drawings of Conveying Plants for Coal, Ore, &c.; only experienced men need apply.—Address, 5067, The Engineer Office. 5067 A

DRAUGHTSMEN, First-class, for Mechanisms, London district; best men only need apply. Good money for real first-class men.—Address, stating age, salary and experience, 4980, The Engineer Office. 4980 A

DRAUGHTSMEN REQUIRED by METROPOLITAN-VICKERS ELECTRICAL CO., Ltd., Trafford Park, Manchester. Applicants must be capable and efficient, and should preferably have had a good experience on Transformer Work.—Apply in first instance by letter to EMPLOYMENT DEPARTMENT, stating age, training and salary required. 4939 A

DRAUGHTSMEN REQUIRED by Well-known Engineers in Eastern Counties; thoroughly experienced and capable of Designing and Detailing all classes of Electric Cranes. Every encouragement will be given to competent men.—Age, experience, salary required, and when free, to Box "LUFFING," c.o. Davies and Co., 95, Bishopsgate, E.C. 2. 5031 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN, SENIOR, First-class Man only, for Midlands Electrical Works; experienced with A.C. and D.C. Motors and Generators.—Address, stating age, experience and salary required, 5005, The Engineer Office. 5005 A

DRAUGHTSMAN WANTED, Experienced in Sheet and Tin-plate Mills.—State experience, age and salary required to W. GILBERTSON and CO., Ltd., Pontardawe, Swansea. 5006 A

DRAUGHTSMAN WANTED, First-class Man, for Internal Combustion Engine Work (Vertical); State age, experience and salary required.—NATIONAL GAS ENGINE CO., Ltd., Ashton-under-Lyne. 5091 A

DRAUGHTSMAN WANTED by a Firm in Midlands, accustomed to Designing Coal Screening and Sorting Plants.—Address, stating age, experience and salary required, 5021, The Engineer Office. 5021 A

FIRST-CLASS DRAUGHTSMAN, Experienced in Automobile Work; must be good mathematician; preference given to a man with Jig and Tool Experience.—Address, 5081, The Engineer Office. 5081 A

THOROUGHLY Experienced DRAUGHTSMAN, accustomed to Frame Structures and Power Station Work. State age, salary, when at liberty, experience.—PREMIER COOLER and ENGINEERING CO., Ltd., Station Works, Shalford, Surrey. 5072 A

FOUNDRYMEN, ARE YOU QUALIFIED to Take up a position as FOREMAN or MANAGER? If not, send for the FOUNDRYMAN'S EDUCATOR. Post 5s.—GREAVES, Harefield Hall, Heywood, Manchester. P8757 A

SITUATIONS WANTED

A.M.I. MECH. E., age 33, Married, at Present Engaged, DESIRES POSITION, Australia; specialised Heat, fuel economy, expert and chemical engineer, gas and coke oven bye-products plants, &c.; fully trained, both practical and commercial; complete control large staffs and labour, with knowledge and foresight to obtain best results; willing act as representative or in managerial capacity. Salary required.—Address, P8675, The Engineer Office. P8675 B

A.M.I. MECH. E. (33) DESIRES POST, 10 Years' experience as representative and demonstrator at home and abroad; thorough knowledge all classes of machinery and mechanical transport; highest references.—Address, P8758, The Engineer Office. P8758 B

A.R.S.M. (26), Terminating Present Agreement, SEEKS POST RESPONSIBILITY at home or abroad; experience mining, mechanical, transportation, commercial, home, Tropics and Canada.—Address, P8726, The Engineer Office. P8726 B

ASSISTANT WORKS MANAGER (39), of Proved ability, 20 yrs.' production experience with high-class firms, SEEKS SIMILAR ENGAGEMENT. —Address, P8746, The Engineer Office. P8746 B

BRITISH EMPIRE EXHIBITION.—MECHANICAL ENGINEER (28), 9 years' experience, OFFERS SERVICES as Representative, Demonstrator or other position; I.C. engines, marine and stationary, machine tools, &c.—Address, P8725, The Engineer Office. P8725 B

CHARTERED CIVIL ENGINEER (University trained), experience 10 years home and colonial railways, 3 years dredging, land reclamation and consulting work, excellent credentials, SEEKS APPOINTMENT, home or abroad.—Address, P8729, The Engineer Office. P8729 B

ELECTRO-PLATING, DEPOSITING, CHEMICAL PLANT.—MANAGER, experienced in design, installation and running, DESIRES POST.—Address, P8699, The Engineer Office. P8699 B

ENGINEER, Long Experience in Mechanical and electrical engineering, including manufacture, commercial and executive, last position manager of a well-known firm, DESIRES SIMILAR POSITION, home or abroad; excellent references.—Address, 5027, The Engineer Office. 5027 B

ENGINEER (32), Energetic, Tactful and Capable, with experience as Works Manager, tool-room superintendent, Rate-fixer, Planning Engineer, Machine and Jig and Tool Designer, is OPEN for ENGAGEMENT in any of these capacities at a moderate salary, but only in Birmingham or district. —Address, P8730, The Engineer Office. P8730 B

ENGINEER (32), with Good Theoretical and Practical experience, knowledge of several foreign languages, is DESIROUS of obtaining SUITABLE POSITION.—Address, P8748, The Engineer Office. P8748 B

ENGINEER (36), B.Sc., A.M. Inst. C.E., 15 years' experience, construction of harbours and docks with their equipment, mechanical and electrical, workshop buildings, bridges, structural steelwork, reinforced concrete, quantities, costs, estimates, executive functions, DESIRES POSITION with progressive firm, preferably as Works Engineer.—Address, P8731, The Engineer Office. P8731 B

ENGINEER, with a Wide Experience in Responsible positions in Oriental countries, now disengaged, REQUIRES SIMILAR APPOINTMENT, preferably on pioneer works, or would consider home appointment where detailed knowledge of conditions abroad could be turned to account.—Address, P8740, The Engineer Office. P8740 B

MACHINE SHOP SUPERINTENDENT or GENERAL FOREMAN, with first-class references, conversant with all kinds of pumping engines and machining condensers, air and centrifugal pumps; good organiser and estimator and able to control men. —Address, P8734, The Engineer Office. P8734 B

MANAGER of Engineering Department of Large Iron and Steel Co., with extensive collieries, specialising in complete colliery equipment, &c., SHORTLY DISENGAGED.—Address, P8743, The Engineer Office. P8743 B

MECHANICAL ENGINEER, Late Manager of small works, SEEKS POST where wide general experience, organising ability, tact and initiative will be of use.—Address, P8755, The Engineer Office. P8755 B

MECHANICAL ENGINEER (24) REQUIRES POSITION in works near London; 8½ years' sea service, B.O.T. certificate; capable of doing running repairs to reciprocating, turbine and all types of boilers and pumps, &c.; excellent references; good knowledge refrigeration and electricity.—Address, P8744, The Engineer Office. P8744 B

MECHANICAL ENGINEER, with Experience as manager of general engineering works and boiler works, used to control of office, estimating, interviewing, designing, maintenance and repairs, is DESIROUS of OBTAINING SIMILAR ENGAGEMENT.—Address, P8760, The Engineer Office. P8760 B

MINES AND RAILWAYS.—CIVIL ENGINEER and SURVEYOR, 9 years' experience abroad, surface and underground work, Portuguese spoken, single, 4 years' war service, REQUIRES POST Abroad; excellent references.—Address, P8732, The Engineer Office. P8732 B

SITUATIONS WANTED (continued)

MINING and METALLURGICAL ENGINEER, Broad commercial and technical experience Russia, U.S., Asia, SEEKS CONNECTION British concern, Bureau of Russia. Thirty-nine years of age, naturalised American; speaks Russian and French; present location Asia. List of references Engineer Office. Will report duty thirty days receipt firm offer.—Address, 4852, The Engineer Office. 4852 B

PRACTICAL ADMINISTRATIVE 43rd Up-to-date ENGINEER, with wide experience of production and tool making, OPEN for ENGAGEMENT, preferably at Wembley Exhibition.—Address, P8747, The Engineer Office. P8747 B

ROLLING STOCK, MECHANICAL STRUCTURAL ENGINEERING.—CHIEF DRAUGHTSMAN, with extensive experience and reliable references, AVAILABLE for Control of Large Office or similar POST.—Address, P8750, The Engineer Office. P8750 B

SITUATION WANTED by YOUNG ENGINEER, aged 22; apprenticed with Messrs. Clayton and Shuttleworth; experienced in fitting and erecting shops and steam test.—Apply, W. FALKINGHAM, Jun., Wistow Lordship, Selby. 5018 B

WEMBLEY.—ENGINEER, Resident in London, DESIRES POST at above; general and constructional experience; age 34.—Address, P8677, The Engineer Office. P8677 B

YOUNG ENGINEER, Discharged end of March, REQUIRES POSITION as Progress Man, Inspector of Work or similar; 2 years shops, 1 year university, 6 months D.O.; moderate salary.—Address, P8717, The Engineer Office. P8717 B

DRAUGHTSMAN, Electric Trucks, Tractors, vehicles and electrical and mechanical knowledge, 5 yrs.' D.O. experience, DESIRES CHANGE; London preferred.—Address, P8739, The Engineer Office. P8739 B

DRAUGHTSMAN (SENIOR), Shortly Disengaged, SEEKS a BERTH; 12 years' D.O. experience, fully conversant in designing, elevating and conveying machinery; gasworks plant, mechanical and constructional, calculations, &c.—Address, 18, Wyresdale, Pershore, Worcs. P8737 B

JUNIOR DRAUGHTSMAN, Age 17, REQUIRES SITUATION; excellent reference, small salary; 3 years' technical engineering institute and 1 year shop experience.—H. PAYNE, 23, Uxbridge-road, W. 12. P8756 B

MACHINE SHOP FOREMAN (36) WANTS POSITION, wide experience, used to modern methods and mass production.—C.o. HAMLYN, Welbeck, Notts. P8742 B

COMMERCIAL RECONSTRUCTIONS, LTD.,
1, POST OFFICE CHAMBERS, DERBY.
Engineering undertakings reorganised by specialists.
Non-paying concerns reconstructed.
Active management where desirable.
Additional Capital in approved cases.
The fullest investigations are invited and required.

PARTNERSHIPS

IF YOU ARE SEEKING
A PARTNER or PARTNERSHIP
or wish to buy or sell a
BUSINESS or WORKS
Write:
WHEATLEY KIRK, PRICE & CO.
46, Watling Street,
London, E.C. 4.
Established over 70 years.

ENGINEER, Gentleman, Fully Trained, DESIRES POST with engineering or manufacturing concern, with view to partnership; capital available.—Apply, JAMES GIBSON and CO., S.S.C., 18, Great King-street, Edinburgh. P8707 C

LONDON ENGINEER, with Good Connection in power stations and consulting engineers, CAN ACQUIRE MAJOR INTEREST in sound SOLE AGENCY; must have, or be able to influence, capital.—Address, P8702, The Engineer Office. P8702 C

PARTNERSHIP.—PARTNER DESIRED, to Replace retiring partner in old-established, well-organised engineering works in Midlands. Sound engineering and commercial training essential. Qualification £6000.—Address, P8688, The Engineer Office. P8688 C

£3000.—ENGINEER to Take Place of Retiring PARTNER; £300 salary.—Address P8744, The Engineer Office. P8744 C

EDUCATIONAL

CORRESPONDENCE COURSES for Inst. C.E., Inst. Mech. E., London Univ. (Matric., Inter. and B.Sc.) personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours), Assoc. M. Inst. C.E., M.S.I., F.R.S.A., &c. Also Day Tuition in Office. Excellent results at all Exams. Courses may commence at any time.—5/11, Trafford Chambers, 18 South John-street, LIVERPOOL. Ex. B

ENGINEERING EXAMINATIONS.—Day, Evening or Correspondence Courses of Preparation for all Examinations. Thousands of successes during the past eighteen years.—G. P. KNOWLES, M.B.E., B.Sc., A.M.I.C.E., &c., 39, Victoria-street, Westminster, S.W.1. Ex.

ENGINEERING SALES MANAGERS.—Our Special Course of Training qualifies students for posts of unlimited scope in this lucrative field. We are prepared to arrange introductions between employers and our trained candidates.—Apply, The INSTITUTE of ENGINEERING SALESMANSHIP, 338, Oxford-road, Manor. P8435 B

TUITION BY POST.—Inst. C.E. and I. Mech. E. Enrol now for next Exams.; 100 per cent. passes last examination. Reinforced Concrete, new comprehensive course under expert engineer, £3 3s. Write for particulars.—PENNINGTONS, University Tutors, 234, Oxford-road, Manchester. Estab. 1876. Ex.

MISCELLANEOUS

POWER ECONOMY TESTS MADE. Mechanical and Electrical Plant Inspected for purchasers. Power Plant and Machine Lay-outs prepared; construction supervised. London office.—Address, P8763, The Engineer Office. P8763 I

TRANSLATIONS (French and German). Accuracy and prompt service.—H. SWIFT, 45, Bishop-street, Moss Side, Manchester. Many years' experience in engineering trade. P8600 I

WELL-EQUIPPED FIRM of MECHANICAL and STRUCTURAL ENGINEERS WISH to NEGOTIATE for the MANUFACTURING RIGHTS of a SPECIALITY. Financial interest in business could be arranged if desired, and applicants are promised a fair deal.—Address, 5064, The Engineer Office. 5064 I

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

British Shipping and the Government.

PRESIDING at the annual meeting of the Chamber of Shipping of the United Kingdom, held in London last Friday, Sir Alan Anderson stated that the world's tonnage of shipping laid up in July, 1923, was something over 8,000,000, as compared with over 9,000,000 gross tons laid up in the same month of 1922. British vessels laid up were, however, coming more rapidly back into service than the general average, the unemployed tonnage having fallen from 1,500,000 gross tons in January, 1922, to 1,008,000 in January this year. Although the laid up tonnage was thus decreasing, he strongly urged that shipowners should break up obsolete or unsuitable vessels, for by doing so they would benefit not only themselves, but the whole world. The action of the late Government in lending money on easy terms to shipowners or shipbuilders, with the object of increasing employment, was, he held, in the nature of a dangerous artificial stimulant. If economic laws were allowed to prevail, orders for ships would gradually increase in volume. On the other hand, every ship built by Government action before its time would postpone the placing of a dozen or more unassisted orders.

Shipyard Wages Claim.

THE negotiations centring around the claim of the Federation of Engineering and Shipbuilding Trades for an all-round increase of 10s. per week in the wages of shipyard workers were advanced a stage by a proposal of the employers to the effect that if the claim were withdrawn they would approve of a joint committee being set up to consider the framing of a new agreement designed to regulate general wage fluctuations in the future. The Executive Committee of the Trades Federation met at York last Friday to consider this proposal. Far from greeting it with approval, several delegates urged that the present application should not only be maintained, but that it should be amended in the direction of seeking an increase greater than 10s. per week. Eventually, a resolution was passed in which it was stated that the Federation could not agree to withdraw the application for the 10s. increase. Immediately this increase was granted, the resolution proceeded, the Federation would be prepared to appoint a Committee to frame a new agreement for the determination of wage fluctuations in the future.

Wireless on Trains.

EXPERIMENTS were recently made on the Great Western Railway with a view to testing the possibilities of listening to the transmissions of the principal broadcasting stations on trains travelling at high speeds. A six valve receiving set was placed in a brake van on the 4.10 p.m. Paddington to Birmingham express, and speech and music were successfully picked up from the London station throughout the whole of the journey. When the train was travelling at a speed of 80 miles per hour, loud-speaker reception at a distance of 40 miles from London was extremely good, the volume being sufficient to enable the music to be heard in spite of the noise of the train; 60 miles from London the strength of the sound was equally good, but at this point the set was tuned to the wave length of the Birmingham station, and the transmissions from that station were received with perfect success. The tests were continued on the 8.10 p.m. train from Birmingham. After receiving special signals from Birmingham, the set was tuned to the wave length of the London station, and it was found that at Leamington the music could be heard on headphones without any interference. The Bournemouth transmissions were also picked up quite successfully.

Colloidal Treatment of Feed Water.

IN the course of a lecture to the Staffordshire Iron and Steel Institute at Dudley on February 15th, Mr. H. W. Bannister urged the merits of colloidal treatment for boiler feed water. Most water softeners, he said, seldom reduced the hardness of the water below 5 deg., which was quite sufficient to produce a hard scale in boilers, while the filtering section of the softener generally did not remove more than 75 per cent. of the deposit, as some of the lime was in the colloidal state, and consequently could not be filtered out. This lime would, nevertheless, produce scale. If soda were used in the softener, it would convert part of the chalk into the colloid form, which also was unfilterable. The colloids could, however, be removed by electrical precipitation.

Escalators on the Central London Railway.

VERY little remains to be done in connection with the work of substituting escalators for lifts and providing a larger booking hall at the Bank Station of the Central London Railway. Since the improvements were begun, over twelve months ago, the work has been going on day and night. Space at the Bank Station is very limited, and the only way of making an improvement was to install escalators. In place of the three lift shafts, there is now an iron tunnel, 25ft. in diameter, which contains the three escalators, the centre one being reversible, so that it can run in either direction to meet the heavy morning and evening traffic. Each escalator is capable of carrying 20,000 passengers per hour. The time taken for the journey between the street and the trains will be reduced to 1½ minutes, the time taken before the alterations were made being 2½ minutes. The alterations will also enable the station to deal with 50 per cent. more passengers every day. Moreover, as the traffic is continually on the move, the congestion which has hitherto been experienced at the lifts will be obviated.

The Airship Dixmude.

THE conditions under which the airship Dixmude was lost early in January aroused so much public anxiety in France that the Minister of Marine appointed a High Commission, composed of three admirals and Marshal Fayolle, to investigate the cause of the disaster and to fix the responsibility for it, if any, upon those whom a previous inquiry had declared to be too high placed to be called into question. The report of the High Commission manifestly seeks to remove the unfavourable impression created by the loss of the airship, as well as by the criticisms of the ill-fated commander, for it affirms that those criticisms were made before the commander had the airship well in hand, and that there was every reason for believing that at the time of the disaster he had complete confidence in its navigability. It is concluded that the Dixmude was destroyed by lightning, and that the disaster might have been prevented if landing stages had been provided in North Africa to avoid the necessity of returning to Cuers when the weather conditions appeared so unfavourable. The report insists upon the difficulty of taking the fullest precautionary measures when the aeroplane and airship are still in a stage of development, and points out that sacrifices are almost inevitable with the progress of the new science. The High Commission obviously seeks to restore confidence in the future of the airship, which has been seriously shaken by the recent disaster.

Foreign Rails for South Africa.

REPLYING recently to a question in the Union House of Assembly at Cape Town, Mr. Jagger, Minister of Railways, stated that the Union of South Africa Railway Administration had placed the following orders for rails with continental firms:—With Krupp and Bochumer Verein, for 80 lb. rails at £6 18s. 6d. per ton, total £87,048; with two Belgian firms, for 45 lb. rails at £6 12s. per ton, total £18,202, and with French firms for 60 lb. rails at £6 7s. 6d. per ton, total £42,075. He explained that the lowest British tenders for the same requirements were at the rate of £8 12s. 3d., £9 5s. and £8 15s. per ton respectively, and that the complete order would have cost £191,520 if placed in Great Britain, compared with £147,325 as placed on the Continent, which showed that British tenders were, roughly, 30 per cent. higher. An order for wheels and axles had, he added, also been placed with Krupps, whose tender was £7733 lower than the lowest British one.

Birmingham to the Sea.

REPORTS in the local Press suggest that the much-discussed project of connecting Birmingham with the sea by means of an improved canal, was put forward a step during a meeting of interested parties which was held last week, but it really seems as if very little has been achieved so far. The meeting, which was held at the Birmingham Council House, included representatives from Bristol, Gloucester, Birmingham, and the canal company. It was agreed that one of the merits of the canal was that it tended to keep down rates of freight on the railways, but some disappointment was expressed on account of the fact that Birmingham did not come forward with an offer of financial assistance to the improvement scheme. Finally, it was decided that representatives of the Corporations and Chambers of Commerce of Worcester, Gloucester and Bristol, the County Councils of Worcestershire and Gloucestershire, the Corporations of Cardiff and Newport, and the Severn Commission should approach the Government with the object of finding what assistance it would give to the scheme.

French Oil Research.

WHEN, in 1919, the French Government inaugurated a programme of oil development and research, with a view to ensuring adequate supplies of liquid fuel for national defence, and had already secured a participation in the oil production of Mesopotamia, it sought to create a technical and commercial organisation which should be able to deal with this new aspect of the fuel problem. For that purpose, it offered special advantages for the formation of a company, which was constituted under the name of the Société pour l'Exploitation des Pétroles, with a large capital supplied by the financial houses, oil refiners and others. So far as Mesopotamia is concerned, the company has had no opportunity to render any material service, and its energies have therefore been devoted entirely to research work on French territory. Investigations into the possibility of finding oil deposits of sufficient importance to be worked commercially have been carried out in the south-east of France, in Morocco, Tunis, New Caledonia and Madagascar, but in no case have the results given any promise of creating an oil industry in France or her Colonies. Having proved that there is nothing to be done, the company has no further reason to continue operations, and it has therefore been dissolved. The disappearance of this important concern, which has worked in close association with the Royal Dutch undertaking, marks apparently the end of the hopes which the French have entertained for some years past of rendering themselves at least partially independent of foreign supplies of liquid fuel.

Old Bridges in the Black Country.

THE opening of a new bridge across the Birmingham Canal at Wolverhampton last week, not only marks one step in an important scheme of road improvements, but also seals the fate of an old bridge. The new bridge itself certainly is not an imposing structure, having cost only £3000, but it replaces a span which dates back 155 years. On it the Cannock road crosses the canal, and originally it was only 10ft. wide. At a later date it was widened to 22ft., and now again the width has been almost doubled. The old structure was a brick arch, nominally 9in. thick, laid in lime mortar, but the friction of the tow ropes of barges passing beneath had worn away the crown to such an extent that it was only 4in. deep in places. Such a bridge was obviously not capable of carrying modern traffic, and it has been replaced by one having brick abutments and a steel troughing floor. The other bridge, which has been replaced, carried the Stafford road over the canal, but in this case reinforced concrete has been used for the new span. Both these works are part of a large scheme for the development of the suburbs of Wolverhampton by means of omnibus services.

Overhead Street Crossings.

WITH his characteristic keen interest and generosity Sir Alfred Yarrow has proposed a scheme to alleviate the increasing congestion of London street traffic by the erection of overhead cross-overs at important traffic junctions. In a letter to *The Times* last week, Sir Alfred offered to erect an experimental elevated crossing at some suitable point—the intersection of Oxford-street and Regent-street was mentioned as a likely spot—provided the structure was allowed to remain for two years so that the value of the experiment could be fully determined. If after that time the bridge was shown to be ineffective, he would also bear the cost of its removal. The elevated roadway proposed would be 18ft. wide, with 18in. on each side for the actual structure, leaving a width of 17ft. on the level on each side of the elevated roadway for the passage of traffic. This width, it may be pointed out, would be 1ft. in excess of that provided in the case of the Blackwall Tunnel, which has a width of 16ft. between the kerbs, and deals with a very heavy traffic. Allowing a gradient of 1 in 13, which rise may be easily negotiated by the London omnibus, it would be necessary to begin the slope about 213ft. away from the actual crossing. The estimated height of the elevated roadway would be 16ft. 6in. from the road level to the underside of the structure, allowing 1ft. clearance for a man 6ft. in height standing on the top of an omnibus. The offer we have referred to has caused considerable discussion, and it will, we learn, come before the authorities concerned at an early date.

The Scottish Shale Oil Industry.

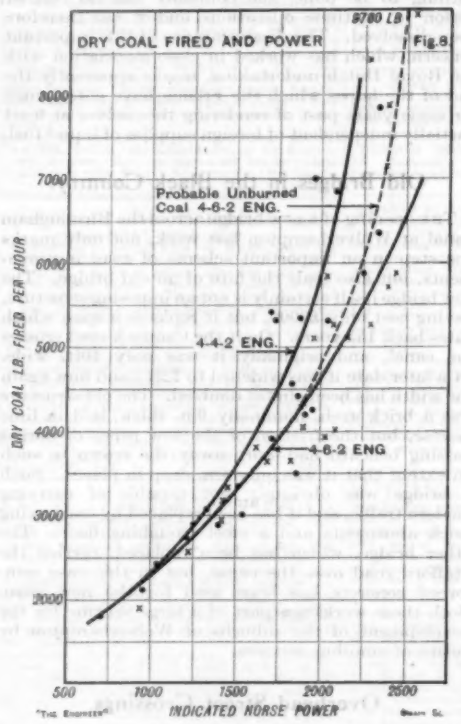
ON Tuesday the President of the Board of Trade received a deputation from the National Union of Shale Miners and Oil Workers and the Scottish Colliery Under Managers' Association, who desired to bring to his notice the position of the Scottish shale oil industry. The deputation drew attention to the statement made by the chairman of the Anglo-Persian Oil Company at the annual meeting of the company as to the unsatisfactory financial position of the Scottish shale industry. Although conditions had improved since then owing to the rise in the price of oil, the workers in the industry were apprehensive lest at some future date proposals for closing down the Scottish mines entirely might be made. They asked the Government, in view of its representation on the Board of the company, to give the workers some assurance that the industry should not be closed down summarily, and they further asked that an inquiry should be set up into the position of the industry. In reply the President informed the deputation that no summary stoppage of the industry would take place without the Government being consulted and given a full opportunity to consider the whole matter. The President promised to discuss with the company certain of the points raised by the deputation.

Locomotive Boiler Performance.

By E. C. POULTNEY, O.B.E.

No. II.*

IN the first section of this article the draught action, fire-box and smoke-box temperatures, and also the evaporations obtained were discussed. In this, the concluding, part the remainder of the sub-sections before mentioned will be considered, commencing with some remarks on the action of the evaporative



heating surfaces in absorbing the heat liberated by the burning fuel on the grate.

ACTION OF EVAPORATIVE HEATING SURFACES AND HEATING SURFACE-GRATE AREA RATIOS.

From the preceding sections, especially those having reference to the fire-box and smoke-box temperatures and the comparative evaporations obtained, the following are the conclusions arrived at regarding the action of the evaporative heating surfaces in absorbing the heat available.

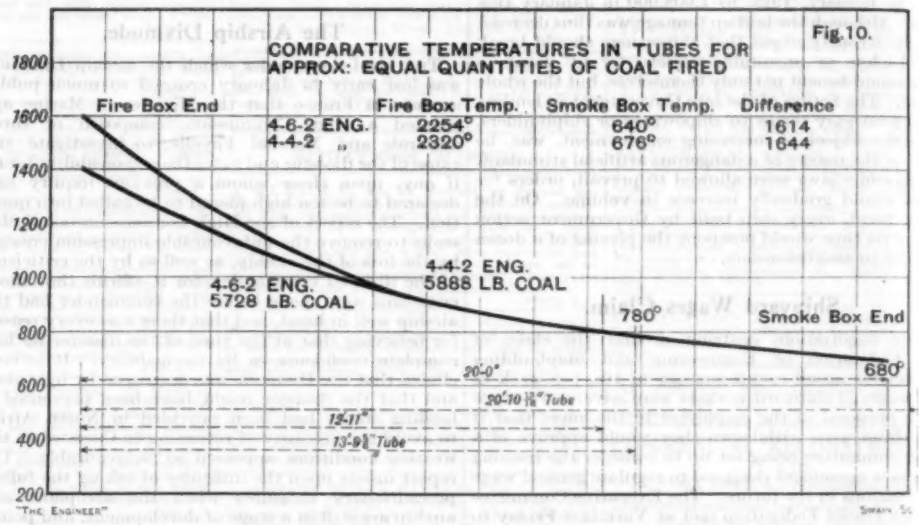
On the basis of a given rate of combustion for the boiler having the larger heating surfaces, a less quantity of fuel is fired per square foot of heating surface, which means that a less quantity of gas is formed relative to the heating surfaces; therefore each cubic foot or each pound of gas passes over a larger amount of heating surface, each square foot of which absorbs a given amount of heat.

The larger the heating surfaces the greater will be the quantity of heat transferred to the water, which will be evaporated in larger quantity for the fuel burned, and the temperature of the terminal or waste gases will be correspondingly low. If a greater quantity of fuel be fired per square foot of heating surface, as would be the case if the boiler had a larger grate in proportion to the heating surfaces, then a greater volume of gas is formed relatively to the heating surfaces, so that each cubic foot or each pound of gas passes over a less amount, and so that while each square foot of heating surface absorbs a certain quantity of heat from the gases, the fact that there is more gas, volume or weight, relatively to heating surface, or, in other words, less heating surface in proportion to the gases available, means that the total heat is not reduced, as it would be had there been larger heat-absorbing surfaces, with the result that less water is evaporated for a given weight of fuel and the waste gas temperatures are higher.

The evaporation, however, per square foot of heating surface is considerable, owing to the larger amount of gas generated per square foot, and the consequently greater heat transfer per square foot of heating surface.

For any given rate of evaporation per square foot of heating surface, other things being the same, equal quantities of fuel will be required per square foot of heating surface; for instance, when boilers are compared on the basis of "equivalent evaporation," the coal required will be inversely proportional to the calorific value. If, therefore, one boiler has more grate surface than the other, then that having the larger grate will be required to burn a given quantity of fuel at a less rate, and on that account will be the more economical. For any boiler the rate of evaporation per pound of coal fired falls as the rate of combustion increases, not because the heating surfaces do not absorb a fixed certain amount of heat from the gases, but because, as the quantity of coal fired becomes larger, less of it is burned and a greater quantity is lost by sparks and imperfect combustion, owing chiefly to the difficulty of passing sufficient air through the fuel bed. In connection with the above Fig. 8 will be of interest, as showing the relationship between the total coal fired per hour and the power developed. For the "Atlantic" engine a rapid increase in fuel consumption is indicated as the output of power increases. The "Pacific" type engine, on account of its more economical boiler performance, shows a more gradual increase in fuel consumption; but it is, however, evident that, at the higher rates of coal firing, evaporation and hence the power developed, did not increase; the fuel fired was not burned.

It would appear that when 8000 lb. of coal were fired, or 150 lb. per square foot of grate per hour, there were very considerable losses through incomplete combustion. Fig. 5 *ante* showed that evaporation begins to fail at that point, and Fig. 3 *ante* that the weight of sparks discharged reaches its maximum at about the same rate of firing. The temperature difference, however, between the fire-box and smoke-box is still about 1700 deg., or what it was when the rate of combustion was only 75 lb. of dry coal per square foot of heating surface, which indicates, as has already been pointed out when discussing the fire-box and smoke-box temperatures, that each cubic foot or pound of gas liberated gives up a certain amount of heat to the heating surface. It therefore seems that failure to increase evaporation in proportion to a given increase in the rate of firing, is not due to the inability of the heating surfaces to absorb the additional heat available from the increased flow of gas, but rather to failure on the part of the fire-box to burn the coal fired effectually.



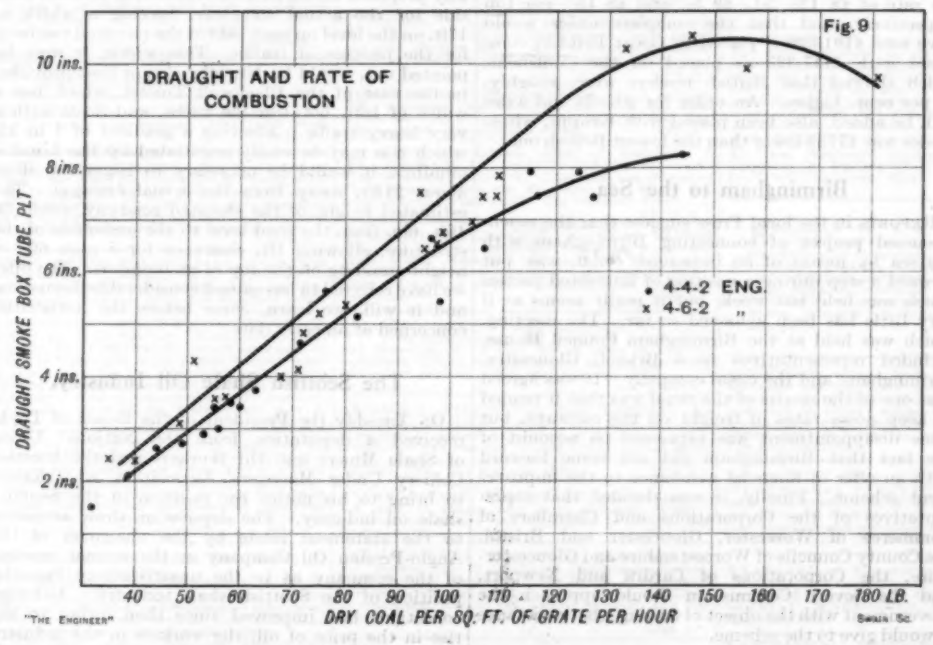


Fig.9
DRAUGHT AND RATE OF COMBUSTION
10 ins.
8 ins.
6 ins.
4 ins.
2 ins.
DRAUGHT SMOKE BOX TUBE PLT
• 4-4-2 ENG.
x 4-6-2 "
40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 LB.
DRY COAL PER SQ. FT. OF GRATE PER HOUR
"THE ENGINEER"

LONG AND SHORT BOILER TUBES.

In connection with a study of the draught records shown by Figs. 1, 2 *ante*, and 9 for any given rate of fuel consumption, the influence of the flue and tube length and also the gas area through the tubes and flues must be taken into consideration. From the particulars furnished of the two boilers under test it will be noticed that the outstanding difference is in the length of the tubes, those for the "Pacific" type locomotive being 21ft. long, as against 13ft. 8in. for the "Atlantic." The ratio of proportion between the gas areas through the tubes and flues and the grate areas is approximately equal, from which it may be concluded that the greater draught necessary to produce a given rate of combustion in the case of the "Pacific" engine is due to the resistance to the passage of the products of combustion offered by the long tubes, which in this case have a ratio of length to inside diameter of 125, as against 94 for the "Atlantic."

Fig. 9 has been prepared to illustrate the comparative draught requirements at the smoke-box tube plate for the two boilers, one having long and the other short tubes. At low rates of combustion the difference is not very marked, but when an increase takes place considerable difference is shown. At a combustion rate of 130 lb. the "Pacific" type boiler requires almost 2in. more draught than the "Atlantic, whilst at 70 lb. per square foot of grate the difference is less than 1in. Further, for a given draught the "Atlantic" burns more fuel, the difference again increasing with the rate of combustion. Within certain limits, evaporation increases with the rate of combustion, so that for a given draught the "Atlantic" type boiler furnishes more steam per square foot of heating surface.

In Fig. 4 *ante* it was shown that at all rates of firing the temperature difference between the fire-box and smoke-box was greater for the "Pacific" type boiler having the longer tubes, and the evaporative performance has been seen to be better per pound of coal fired, and hence the boiler efficiency higher, more heat being absorbed. In deciding, then, how long tubes should be for a given locomotive having other related characteristics the same, the question to be answered appears to be how far or to what extent is economical steaming to be sacrificed in the interests of greater evaporation or free steaming. In this connection and in order that some idea may be formed as to the probable useful length for a tube of a given diameter Fig. 10 has been prepared to show the temperatures of the products of combustion as they flow through the tubes. In the tests the tube temperatures were obtained by a long thermo-couple inserted in a suitable tube 30ft. long, so that it would

* No. I. appeared February 22nd.

reach through the smoke-box and through the tubes to the fire-box end.

The couple was carried in the tube, the temperature of which was to be measured, by a star-shaped support, so that the couple was in the centre of the tube. The couple, after being inserted in the tube, was slowly withdrawn, the temperatures being taken at each foot of length of the tube. The flue tubes were treated in the same manner, but in this case the thermo-couple had to rest on the bottom of the flue on account of the elements. The temperatures, both in the tubes and flues, increased with the rate in firing, a condition which would be expected in view of the temperature records indicated by Fig. 4. The principal feature shown by Fig. 10 is the remarkable fall in the gas temperatures immediately on entering the tubes, and also the rapid fall in temperature during the first half of the length of each tube.

The curve for the first half falls quickly, and during the last half is very flat, indicating a much slower dissipation of the heat. The temperature in the smaller tube is 780 deg. 12ft. 11in. from the fire-box. In the case shown for about equal quantities of coal fired the temperature difference is about equal, but from the temperature records shown by Fig. 4 it was seen that the smoke-box temperatures were lower by about 100 deg. for the "Pacific" type boiler, the difference showing a tendency to increase at the higher rates of firing. It is evident from Fig. 10 that the temperature difference which takes place during the last 7ft. of the longer tube is very slight, apparently not more than about 50 deg., whilst from the run of the curves it would seem that the shorter tubes, if lengthened, might be more efficient in absorbing heat, for although the curve flattens considerably after the first half, there is a perceptible fall in temperature shown during the second half of their length.

Fig. 10 shows the temperature condition for fuel consumptions of 5888 lb. and 5728 lb. per hour for the "Atlantic" and "Pacific" boilers, which correspond to firing rates of 104 lb. and 106 lb. per square foot of grate per hour, and from Fig. 9 it will be seen that the draught requirements are 7in. and 7.9in. respectively. The shortening of the tubes in the longer boiler would tend to reduce the resistance offered to the flow of the gases, and with the same draught lead to an increase in the rate of combustion, and because of that the somewhat reduced heating surface might give an equal total evaporation per hour.

There would, however, be some loss of heat due to increased terminal temperatures and a slightly lower boiler efficiency for a given rate of firing, because the longer tubes certainly effect a reduction in the smoke-box temperatures though their heat-absorbing value per unit of length is small and the value of the tube heating surface correspondingly reduced. On the other hand, shorter tubes allow of more fuel to be fired for a given draught, and the increased activity of combustion gives a greater evaporation per square foot of heating surface, a condition which is generally to be preferred in locomotive practice, where weight considerations per unit of power are usually of importance.

The temperature observations made showed that the particular position of the tube in the tube sheets made little or no difference to the temperatures; that is, tubes high up on the sheets showed much the same gas temperature as those set lower. The flue tube temperatures were for the "Atlantic" from 100 deg. to 200 deg. higher than those recorded in the tubes, whilst those in the "Pacific" type boilers generally indicated lower gas temperatures by about 80 deg. The report expresses the view that these temperature readings may be in error, as great difficulty was experienced in obtaining definite readings, owing to "unstable conditions." It seems reasonable to suppose that the gas temperatures might be higher in the larger tubes, owing in part to the larger volume of gas flowing through and passing over a hot tube surface, viz., the superheater elements.

Superheater Performance.

When the superheater forms an integral part of the boiler itself, as is the case with the Schmidt or flue-tube type as fitted to locomotive boilers, part of the heat units liberated by the fire-box are not available for evaporative purposes; they are absorbed by the heating surfaces formed by the elements comprising the superheater. The amount of heat taken up by the superheater depends upon the comparative volume of the gases which pass through the large tubes or flues, and the extent of the superheating surfaces and their position relative to the hottest part of the boiler which, in the case of the locomotive type of boiler, is the fire-box. Usually the elements are carried back to about 2ft. from the fire-box tube plate, and such was the case with the boilers now under consideration.

The evaporative performance of the boiler and superheater combined per square foot of heating surface per hour was shown for the two boilers by Fig. 5 *ante*, and in Fig. 11 the equivalent evaporation of the boiler and superheater per square foot of heating surface is given separately plotted against the rate of firing dry coal per square foot per hour. The heat transfer across the water heating surface is proportional to the equivalent evaporation of the water, and that across the superheating surface is proportional to the weight of steam delivered to the engines and the heat units added during its passage through the elements, the equivalent evaporation of the superheater being proportional to the heat transfer thus obtained. The curves plotted, giving the relative evaporations, indicate the effectiveness of the evaporative and superheating surfaces in absorbing heat. The "Pacific" type boiler furnishes an equivalent evaporation per square foot of water heating surface of from 6.78 lb. to 17.26 lb. with a corresponding evaporation of from 1.82 lb. to 7.36 lb. of water for each square foot of superheating surface. The ratio of proportion of equivalent evaporation which takes place in the boiler and superheater varies from a minimum of 0.27 to a maximum of 0.42, showing that each square foot of heating surface in the superheater absorbs from 27 to 42 per cent. of the amount of heat taken up by a square foot of water heating surface, the average for these tests being about 36 per cent. In the "Atlantic" type boiler, the equivalent evaporation per sq. ft. of water heating surface for which was from 8.42 lb. to 19.68 lb. per hour, the equivalent

Fig.11.

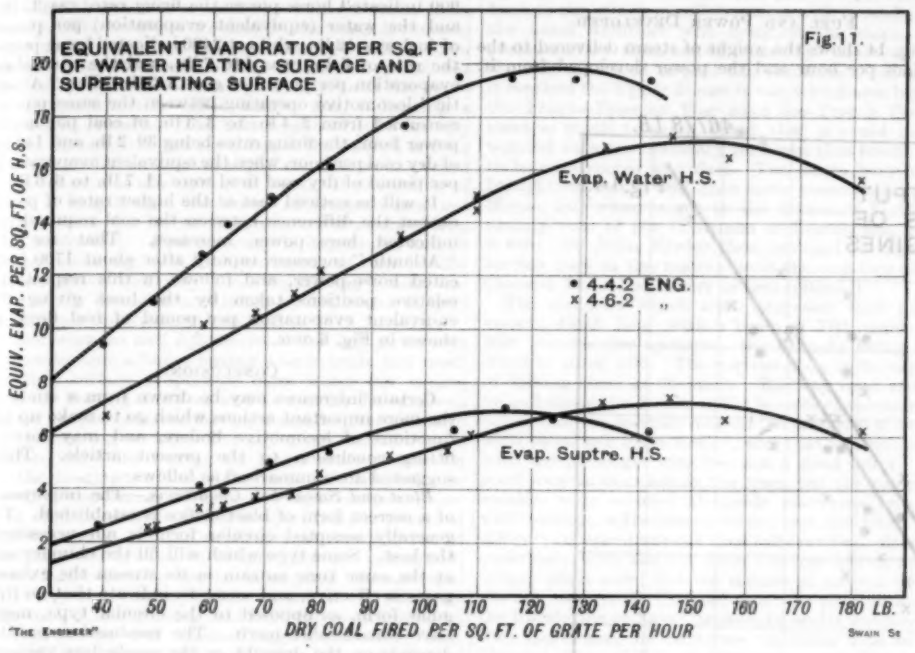

EQUIVALENT EVAPORATION PER SQ. FT. OF WATER HEATING SURFACE AND SUPERHEATING SURFACE
EQUIV. EVAP. PER SQ. FT. OF H.S.
Evap. Water H.S.
• 4-4-2 ENG.
× 4-6-2 „
Evap. Suptre. H.S.
DRY COAL FIRED PER SQ. FT. OF GRATE PER HOUR
"THE ENGINEER"
SWAIN Sc

Fig.13.

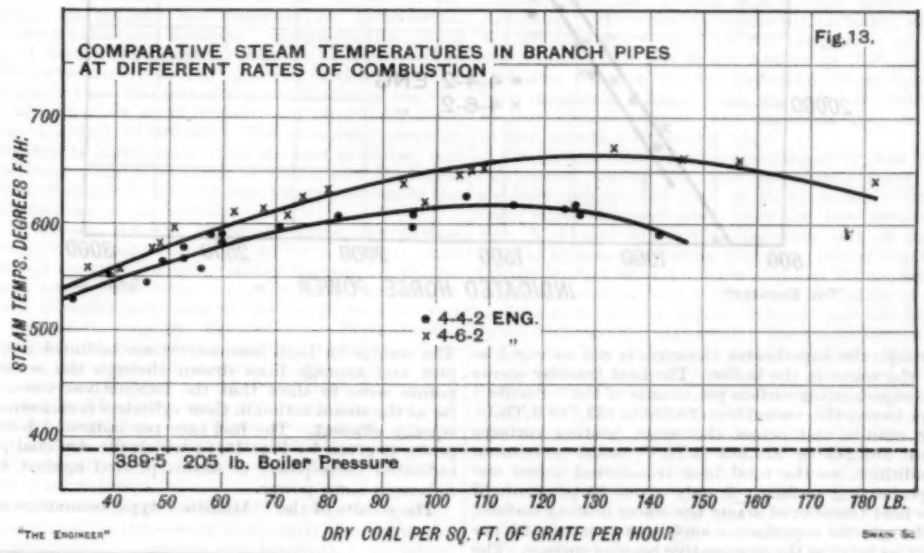
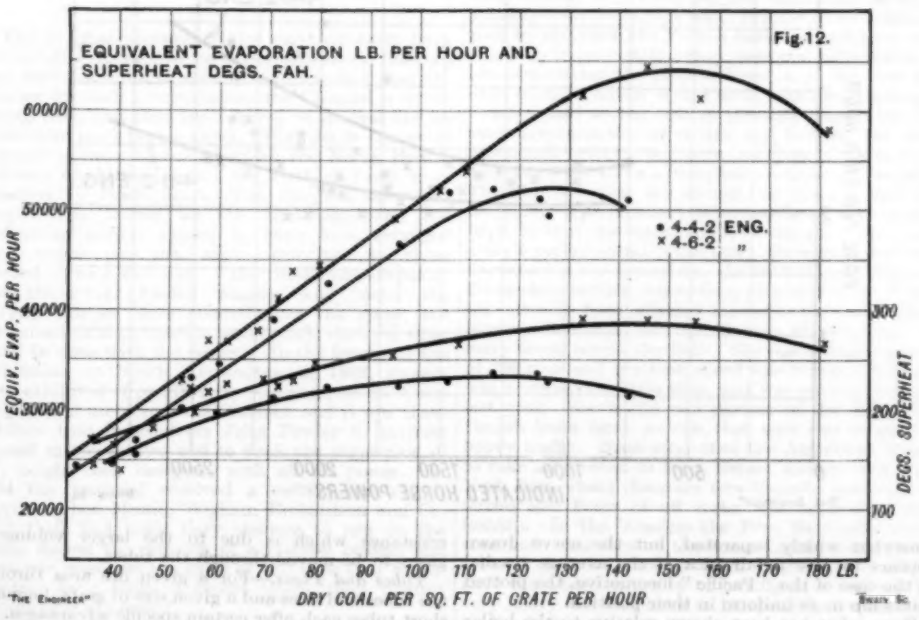

COMPARATIVE STEAM TEMPERATURES IN BRANCH PIPES AT DIFFERENT RATES OF COMBUSTION
STEAM TEMPS. DEGREES FAH.
• 4-4-2 ENG.
× 4-6-2 „
389·5 205 lb. Boiler Pressure
DRY COAL PER SQ. FT. OF GRATE PER HOUR
"THE ENGINEER"
SWAIN Sc

Fig.12.


EQUIVALENT EVAPORATION LB. PER HOUR AND SUPERHEAT DEGS. FAH.
EQUIV. EVAP. PER HOUR
DEGS. SUPERHEAT
• 4-4-2 ENG.
× 4-6-2 „
DRY COAL PER SQ. FT. OF GRATE PER HOUR
"THE ENGINEER"
SWAIN Sc

evaporation from the superheating surface was from 2.0 lb. to 7.01 lb. In this case the ratio of equivalent evaporation in the boiler and superheater per sq. ft. of heating surface varies from 0.237 to 0.356, or, in other words, the superheating surface absorbs from 23.7 to 35.6 per cent. of the amount of heat absorbed by each square foot of water heating surface.

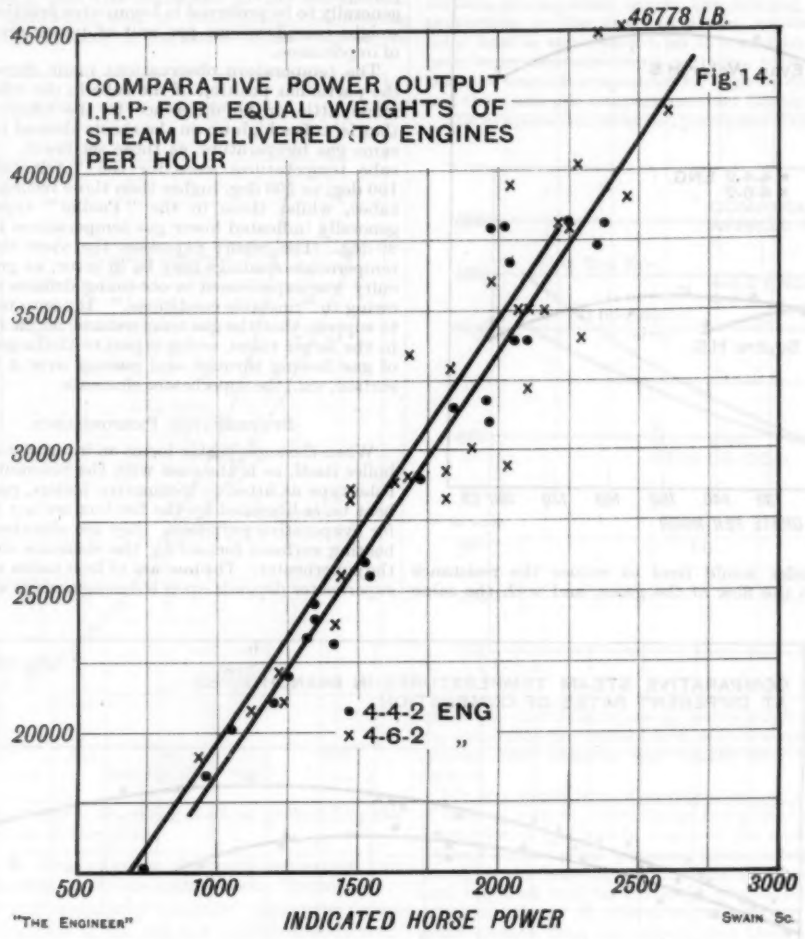
The absorption of heat by the steam passing through the superheater elements is not so rapid as by the water in the boiler. The heat transfer across the superheating surface per minute of the "Pacific" type locomotive varied from 28,854 to 133,740 B.Th.U. per minute and across the water heating surfaces from 364,243 to 929,583 B.Th.U. under maximum conditions, so the total heat transferred across the superheating surface was only about 14 per cent. of the heat transferred across the water heating surface, although the superheater surface was nearly 30 per cent. as large as the evaporative heating surface. The boiler on the "Atlantic" locomotive transferred from 21,259 to 79,513 B.Th.U. and from 328,917 to 764,269 B.Th.U. per minute for the superheating and evaporative heating surfaces respectively, so that for this boiler the rate of transfer across the superheating surface was about 10 per cent. of the heat transfer across the water heating surface, the area of the superheating surface being about 25 per cent. as large as the evaporative heating surface.

Fig. 12 gives the equivalent hourly evaporation for each boiler at rates of firing from 40 lb. to, in the case of the "Atlantic" type boiler, 142 lb., and in the case of the "Pacific" 181 lb. of dry coal per hour, and also the degree of superheat obtained. The "Pacific" type boiler furnishes an equivalent evaporation of 64,700 lb. per hour, and at the same time the superheat attained is 280 deg., while the smaller boiler is seen to attain a maximum equivalent evaporation of 52,000 lb. per hour, the superheat at the same time being 230 deg., the curves showing the degrees of superheat, and, as mentioned when discussing Fig. 4 *ante* in connection with the fire-box and smoke-box temperatures, indicate that it remains practically constant at the higher rates of combustion and only falls off when the rate of evaporation begins to decline. The curves of superheat temperatures are, of course, exactly similar to those shown in the preceding figure, indicating the equivalent evaporation or the work done per square foot of superheating surface.

Fig. 13 gives the total temperature of the superheated steam as delivered to the engines. They are similar to those in the preceding two figures, and are plotted against the rate of combustion. The temperature readings were taken from a point in the branch pipe between the superheater header and the steam chests. The degree of superheat follows the rate of evaporation and the large boiler evaporates the most water, while its superheater furnishes steam at a temperature which reaches a maximum of 670 deg. Between combustion rates of 90 lb. and 156 lb. of dry coal per square foot of grate per hour, the steam temperature is between 640 deg. and 670 deg., during which the rate of evaporation is from 48,500 lb. to 64,000 lb. per hour.

Fuel and Power Developed.

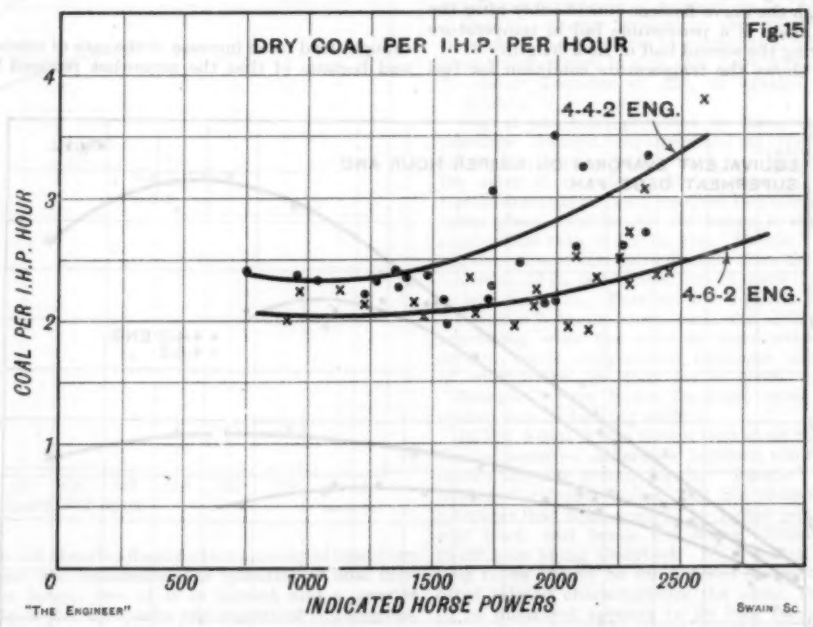
Fig. 14 shows the weight of steam delivered to the engines per hour and the power developed from it.



The results for both locomotives are included in the plot and average lines drawn through the several points seem to show that the locomotives were, so far as the steam action in their cylinders is concerned, equally efficient. The fuel rate per indicated horse-power is given by Fig. 15, in which the dry coal per indicated horse-power is shown plotted against the indicated horse-power.

The results of the "Atlantic" type locomotive are somewhat widely separated, but the curve drawn appears to give a fair idea of the average results. In the case of the "Pacific" locomotive, the plotted points are more uniform in their position.

From what has been shown relative to the boiler performance of the two locomotives, and having in mind the results indicated by Fig. 14, the coal rate results exhibited by Fig. 15 are as would be expected.



The "Pacific" type locomotive is the more economical of the two locomotives. Between 900 and 2400 indicated horse-power, the coal consumption per horse-power hour is from 2.1 lb. to 2.4 lb. At 900 indicated horse-power the firing rate was 35 lb., and the water (equivalent evaporation) per pound of fuel was 12 lb., while at 2400 indicated horse-power the rate of firing was 146.7 lb., and the equivalent evaporation per pound of coal 8.2 lb. The "Atlantic" locomotive operating between the same powers consumed from 2.4 lb. to 3.3 lb. of coal per horse-power hour, the firing rates being 39.2 lb. and 142 lb. of dry coal per hour, when the equivalent evaporations per pound of dry coal fired were 11.7 lb. to 6.6 lb.

It will be noticed that at the higher rates of power output the difference between the coal required per indicated horse-power increases. That for the "Atlantic" increases rapidly after about 1700 indicated horse-power, and follows in this respect the relative positions taken by the lines giving the equivalent evaporation per pound of fuel fired, as shown in Fig. 6 *ante*.

Conclusion.

Certain inferences may be drawn from a study of the more important actions which go to make up the functions of locomotive boilers, and may form a fitting conclusion to the present article. Those suggested are summarised as follows:—

Blast and Smoke-box Conditions.—The importance of a correct form of blast orifice is established. The generally accepted circular form is not necessarily the best. Some type which will fill the chimney and at the same time entrain in its stream the exhaust gases is effective, and seems to indicate that an irregular form, as opposed to the circular type, might have considerable merit. The combustion possible depends on the draught or the smoke-box vacuum, which, in turn, depends upon the efficiency of the blast. There are considerable heat losses, through the throwing of sparks, which increases with the rate of steam production, owing to the greater draught action brought about by the increased quantity of steam discharged by the blast pipe. This, again, points to the importance of the form and size of the exhaust nozzle. While a study of the general performance characteristics shows beyond question how dependent are the various actions upon each other, it is possible that some form of blast nozzle which could be increased in size at high power output might offer advantage.

Temperatures and Draught Readings: Fire-box and Smoke-box.—A boiler having a large grate area in proportion to the heating surface gives at all rates of combustion higher terminal or smoke-box temperatures than one having large heating surfaces and a comparatively small grate. For any boiler the temperature difference for all rates of firing is about the same. The gases liberated by the burning fuel, no matter how great their volume, are always reduced in temperatures by a certain amount. The degree of temperature soon reaches a maximum value and remains almost constant throughout the higher rates of combustion. Fire-box draught readings increase with the rate of combustion, indicating greater resistance, caused, probably, by the thicker fire carried. The smoke-box draught increases with greater quantities of fuel fired, and shows continually increasing resistance which is due to the larger volume of gases to be moved through the tubes.

Tubes and Flues.—For a given fire area through the tubes and flues and a given size of grate, long and short tubes each offer certain specific advantages. A long tube takes up more heat and is therefore more efficient so far as evaporation is concerned, but for a given rate of combustion requires more draught than

a shorter tube. A short tube liberates more heat in the terminal gases, but for the same draught the rate of combustion is higher, and a greater evaporation is effected per square foot of heating surface. The fire burns better and the boiler steams more freely. The temperature drop in the tubes is remarkably rapid for approximately the first half of their length from the fire-box end. After that point, the gas temperatures fall more gradually until the curve of temperatures becomes almost flat, indicating a slow heat transfer. The best length of tube for any given diameter would seem to be that which is long enough under average draught conditions to permit of a reasonable absorption of heat. It should be of such a length that the curve of temperatures has just become flat before the gases are discharged into the smoke-box. Fuel economy is important, and so is free steaming, and the best length of tube is that which meets half way these conflicting conditions. The inside diameter multiplied by 100 seems to give a safe rule for the length in inches.

Evaporations and Efficiencies.—For any given rate of combustion a boiler having a large grate and small heating surface evaporates more water per square foot of heating surface, and is smaller for a given power output than one having a smaller grate relative to the heating surface. For any given rate of evaporation, the boiler having the larger grate in relation to the heating surface is the more efficient, because for any evaporation the rate of firing is less per square foot of grate and the water evaporated per pound of fuel is greater. So far as the actual consumption of fuel and the process of evaporation are concerned, loss of efficiency is due to incomplete furnace conditions, and not to any failure on the part of the heating surfaces in absorbing heat from the gases available.

Superheaters and Steam Temperatures.—For any size of boiler the addition of a flue tube superheater reduces the area of the evaporative heating surfaces and also the amount of heat available for evaporation purposes. A boiler of the same size having equal amounts of heating surfaces supplying saturated steam, is more efficient than one of the same size and having the same amount of combined heating surface (water and superheating). It more effectually absorbs the heat available. This is due to the fact that the superheater-fitted boiler has less evaporative heating surface per square foot of grate, and also to the superheating surface being less efficient in the transfer of heat than is the water-heating surface. The degree of superheat imparted to the steam passing through the superheater increases with the rate of evaporation. As the evaporation increases with an increase in the volume of the gases forming the products of combustion, so does the superheat. This condition is further assisted by the increase in the relative effectiveness of the superheating surfaces as the rate of working increases.

Coal Consumption and Power.—The coal rate for any given power is dependent on the efficiency with which the boiler does its work, which consists of evaporating water. While in the present article no reference of any length has been purposely made to engine performance, it is known that the addition of the flue tube superheater giving high degrees of superheat to the steam has improved cylinder performance almost beyond recognition. So much so, in fact, that it seems that further fuel economies must be largely obtained by improved boiler operation, and the fire-box and grate seem to offer the most promising field for investigation.

The Train Ferries.

THE re-establishment of the war-time train ferry service on a commercial basis to run between Harwich and Zeebrugge draws attention to the fact that the scheme for such a route across the Channel is by no means new, and that train ferries in general are far older than most people think. The first in the world appears to have been that which the North British Railway established across the Firth of Forth from Granton to Burntisland. The ferry steamer employed was known as the Leviathan, and the embarking bridges appear to have been arranged very much on the same principle as those erected during the war. Her maximum capacity was thirty-four loaded wagons, and until the railway bridges were erected over the river, she performed extraordinarily useful work, showing what could be done with the system. In the International Exhibition at South Kensington in 1862, models were exhibited of paddle ferry steamers, which it was proposed to use across the Channel, and it was these exhibits that induced Sir John Fowler to interest himself in the matter and to back the suggestion of Mr. Leigh, their designer, with all his power. In 1864 the proposal received a certain amount of support, when Messrs. Wigham Richardson and Co. built their first train ferry steamer to run on the Rhine during the erection of a railway bridge, and when one considers the ships of this type that Swan-Hunters have built of recent years, their modest beginning is of interest.

Backed by these precedents, Sir John Fowler put his suggestions and those of Mr. Leigh into concrete form in 1865, and presented them to Parliament. The Admiralty immediately objected to the proposal on the grounds of national defence, basing its attitude principally on the position in Dover that had been chosen for the terminus. Such a difficulty was not by any means insurmountable, and Fowler was soon back to the attack in collaboration with Scott Russell, the naval architect who designed the ships. The parliamentary fight lasted from 1867 to 1870, when the Bill contrived to pass the Commons; but before it reached the Upper House it was withdrawn because the Franco-Prussian War gave the French Government so much to think about that it could not be worried with the necessary terminus that would have to be constructed at Calais. Two years later it was brought up again, and once more passed the Lower House, but when it got to the House of Lords the casting vote of the Chairman of Committees threw it out. Sir John Fowler then declined to take any further part in the matter until the question of the Channel Tunnel was more or less settled.

The steamers which were proposed were paddle vessels, 450ft. long, with a beam of 57ft. inside and 80ft. outside the sponsons, the draught being kept down to some 12ft. The engines were to be capable of driving them at 20 knots. Railway lines were to be laid along the decks, and it is rather interesting to notice that the designer realised the one great difficulty with passenger train ferries, and that is what to do with the passenger who was not a good sailor. The good wagons were left in the open, but the passenger coaches were secured alongside platforms provided with saloons, refreshment rooms and the like. The difficulty of speed was not then fully realised, although experience with the war-time Channel ferries makes it very plain now; but the matter of motion with a shallow steamer in Channel seas was pointed out at the Institution of Naval Architects, and it was obvious that there were no harbours on either side of the Channel that could accommodate such big ships. Fowler was not to be daunted by a little thing like that, and therefore proposed to construct special works alongside the Admiralty Pier at Dover, and, as Calais was fairly hopeless for the purpose, to construct an entirely new harbour at Audresselles, between Calais and Boulogne. Hydraulic lifts, which Lord Armstrong designed, were to be employed to lift the trains up to the steamers' decks when tide demanded it. The cost of the whole scheme was first of all put down at £2,200,000, and afterwards made into a round £3,000,000. The Admiralty strongly objected to interference with the pier at Dover, and the local authorities, both at Calais and Boulogne, threw themselves bitterly into the opposition to the new harbour at Audresselles.

In France, Admiral Dupuy de Lôme, the famous designer, strongly objected to this scheme, and instead suggested a new railway harbour at Calais, some half a mile from the shore. He also sought Scott Russell's assistance in the design, and evolved a ship 440ft. long by 50ft. wide by 13½ft. loaded draught, with a maximum speed of 18 knots. Both these designs were objected to on the grounds that the lines of railway would force them to have a divided paddle shaft, with all its obvious dangers, and jet propulsion was therefore suggested in place of paddles. The whole matter of design was very hotly debated in the Institution of Naval Architects and in other places.

It has been mentioned how Lord Armstrong interested himself in the scheme in the early 'seventies, and he maintained his interest until his death, being joined in his enthusiasm by Sir William White, who at that time had not left Elswick to become Director of Naval Construction. Together they evolved an infinitely more practical ferry steamer, driven by twin screws, very much on the same lines as those actually built during the war. It must be remembered that by this time the French harbours had been considerably improved, but they were still not capable of accommodating the proposed vessel, as she had two lines of rails, which would each take nine passenger coaches, and at the side of the ship there were the same arrangements of cabins and buffets that were mentioned before; but over the roofs of the railway cars there was to be a complete shelter deck as well. The idea was that she should run straight into the berth, and both bow and stern were fitted with hinged flaps, so that the trains could be run off. She, however, is rather ahead of our story, for a good deal had happened in the meantime. In 1872 Messrs. Wigham Richardson and Co., whose ferry steamer for the Rhine has already been alluded to, built the train ferry steamer Lillebelt for the Danish Government, to carry trains across the Belt. She had a displacement of 390 tons and her best speed was 9 knots, but she was a wonderful little ship, and was only broken up last year. She is the real pioneer of the wonderful Danish train ferry service that now carries such a heavy traffic. Soon after that the Americans began to take an interest in train ferries, and in 1878 New York Bay, where there are now literally hundreds of ferries and floats of all sorts, was crossed in this fashion. In the 'nineties the Père Marquette route came into existence on the Great Lakes, where there are now quite a number of train ferry services. They have the added difficulty of having to contend with very heavy ice, and have to be specially designed as ice-breakers.

The Italians founded their service across the Straits of Messina in 1899, and soon after, the trend of affairs in the Far East, that led to the Russo-Japanese War, caused Lake Baikal to be provided with an ice-breaker ferry on American lines; but in this case the ice soon got beyond the power of the breaker, and the rails were then laid over its surface. In 1905 the Dover-Calais scheme was again brought into prominence with the material that Sir William White and Armstrongs had evolved, and in 1909 the big Sassnitz and Trelleborg ferry was opened by joint arrangement of the Swedish and German Governments. Magnificent ships were built for this run, ships of well over 4000 tons displacement, capable of steaming at nearly 17 knots, and seaworthy enough to stand the heavy weather that they are likely to meet on their 65-mile crossing. The Swedish ships have maintained this service steadily ever since, but the German vessels were taken over during the war and converted into minelayers, the long lines of rails ending in an open stern making them particularly useful for this purpose. Meanwhile, new routes had been opened in the United States, and although as steamers the ships employed were not so fine as those on the Swedish run, they were frequently bigger, particularly those that connect San Francisco with the main lines across the continent.

Just before the war there was built on the Tyne a new form of ferry steamer, named Leonard. She had no expensive raising and lowering bridge to get her trains on board, machinery for the adjustment necessary to suit the tide being built into the ship itself, and raising or lowering the train decks as required. As far as sightliness was concerned, the result was horrible, but the Leonard was very efficient in her work, and ran across the St. Lawrence at Quebec. She had three tracks, and being built for Transatlantic rolling stock, she could only take thirty-three ordinary British wagons. When it was safe to be at sea with the rail decks raised, she could stow a large quantity of cargo in the space underneath them. She was fast and shallow, and was considered a success, being brought back to Europe at the latter part of the war and taking her maiden passage between Southampton and France a few days before the Armistice. Her route was across to Cherbourg, where she afforded great relief to the congestion of the other lines. She was finally known as T.F. No. 4, and after the war, the St. Lawrence Bridge having been completed by that time, she was not returned to her original owners, but converted into an oil tanker, as which she still exists.

The greatest train ferry service, however, was that maintained during the war, principally from the specially constructed port of Richborough. Three train ferry steamers were built for this service—Nos. 1, 2, and 3—each having four sets of rails, capable of accommodating fifty-four 10-ton wagons. Lifting bridges were built for them at Richborough and Southampton, and it only took a matter of 20 minutes to get all the wagons on board, secured down to the deck and the ship away. They were fast ships and could always be relied upon for 13 knots, though their shallow draught made them none too comfortable in a Channel sea, which must not be taken to suggest that they are bad sea-boats. They have two sets of machinery, one on either side of the ship, and have oil-fired boilers. For most of the time the service was running, Nos. 1 and 3 were on the Richborough route, taking over colossal quantities of stores, and practically all the tanks, while No. 2 was stationed at Southampton and ran to Dieppe. The Germans knew all about the service, and would have very much liked to have stopped it, but the steamers were well armed and the route was well patrolled, while their shallow draught was an added protection against ordinary torpedo work.

After the war they were employed to bring back all the salvable material from France that could be got away, being managed by the South-Eastern Railway during part of the time. One was then sent to Ireland to get away our military stores after the establishment of the Free State, the wagons being lifted on to her decks with cranes in the absence of any proper facilities. Last year an attempt was made to run a service to Calais for the French vegetable trade, but it was rather half-hearted, and soon dwindled and stopped.

These ferry steamers have now being taken over for the new Great Eastern service, and will run between Harwich and Zeebrugge. Their convenience for many classes of goods, especially perishable foodstuffs which are carried in refrigerated rolling stock, is so great that, given the proper organisation and support, there is little doubt that they will handle a huge traffic. Naturally, they will meet with strong opposition from the established lines, but the promoters of the scheme have gone about it thoroughly, and have cast their net far afield in arranging for traffic. So that it appears that after all the scheme that Sir John Fowler dreamed fifty odd years ago is to come at last; whether it could have been so or not had there been no war, is a very open question.

CRANES AT THE ACTON WORKS OF THE UNDERGROUND RAILWAY.—In our article on the Underground Railway's new repair works, appearing in our issue of February 15th, it is stated that the 35-cwt. electric jib cranes serving the hydraulic presses were built by Gibbon Brothers. We are informed however, that this is incorrect, the builders being Richard C. Gibbins and Co., of Berkley-street, Birmingham.

Institution of Mechanical Engineers.

THE annual general meeting of the Institution of Mechanical Engineers, which was held at Storey's-gate on Friday, February 22nd, was noteworthy on account of the brevity of the formal business transacted.

The report of the Council, which was accepted unanimously, shows that 493 new members were elected during the past year, making the total membership on December 31st, 1923, 9227. The Iron Alloys Research Committee has made progress in overcoming the initial difficulties, and some costly furnaces and apparatus have been installed. It is said that developments are now in sight which may prove of very great value. Further investigations were carried out during the year by the Cutting Tools Research Committee on the stresses set up in the workpiece ahead of the point of the tool in planing, and on the abrasive force exerted by the chip on the tool. Some experiments on the mechanism of deformation of the metal around the tool were also carried out. The research work on hardness tests was continued, and included the scratch method of testing. The Marine Oil Engine Trials Committee carried out tests on Beardmore-Tosi, Scott-Still and Werkspoor engines. These trials were so arranged that the results are readily comparable. It was further reported that the Heat Engines and Boiler Trials Committee had formed six panels which are dealing with :—Panel A : Revision of the boiler and reciprocating steam engine code, published 1913. Panel B : Steam turbines and turbo-generators for land purposes. Panel C : Steam turbines for marine purposes. Panel D : Gas engines and gas producers. Panel E : Petrol and paraffin engines. Panel F : Heavy-oil engines. The experiments of the Steam Nozzles Research Committee were continued in Manchester, and sufficient material had been collected for the compilation of a third report ; while work for the Wire Ropes Research Committee had been carried on at the Woolwich Polytechnic. The Engineering Joint Council, the report continued, had been established. It consisted of two members of the Council of each of the following Institutions in the first instance, appointed from time to time by their Councils severally :—The Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects, and the Institution of Electrical Engineers—which were called the Founder Institutions. The members of the Joint Council were, it was explained, to be appointed annually, and were to be eligible to serve for not more than four years consecutively. The chairman would be elected annually by the Joint Council, and the secretary of the Institution represented by the chairman for the year would act as secretary of the Joint Council. The chairman would be chosen from the several Institutions in rotation. The Joint Council would consider matters referred to it by the Council of any one of the constituent Institutions. It would not initiate proposals affecting the Institutions, and would be an advisory body without executive powers.

The scheme for the award, in conjunction with the Board of Education, of national certificates and diplomas in mechanical engineering had been carried on. Examinations, held at 77 technical schools and colleges at the termination of approved courses, were attended by 1427 candidates, as a result of which there were awarded 606 ordinary and 122 higher certificates, 38 ordinary and 30 higher diplomas. The scheme, it was added, now included 87 schools. A similar scheme had been arranged for the award of national certificates and diplomas in conjunction with the Scottish Education Department.

As soon as the report had been accepted by the meeting, the President, Sir John Dewrance, proceeded to distribute the prizes. The Thomas Hawksley Medal went to Professor Gibson, and the Premiums to Messrs. Wright Baker, and Young. Bernard Hall Prizes were awarded to Mr. Dempster Smith, Dr. Walker and Professor Burstall ; certificates were given to Messrs. Harry Wood and Kearton ; and prizes to Messrs. Dolland, Bond, Hollands, Hockley, and Barrell. The Institution Examination Prizes were gained by Messrs. Henson and G. Parker.

The results of the ballot were then announced by the Secretary, as follows :—President, W. H. Patchell ; Vice-presidents, W. H. Allen and W. Reavell ; members of Council, Vice-Admiral Sir G. Goodwin, Messrs. H. N. Gresley, L. T. G. Mansell, W. Taylor, Sir J. E. Thornycroft, and Mr. R. Williamson.

Sir John Dewrance then invited Mr. Patchell to take the chair as new President, and Mr. Patchell, in thanking the Institution for electing him, commented on the magnitude of the task of steering the Institution, but hoped that he would at the end of his term of office leave it at least in as strong a position as when he took the chair.

Captain H. Riall Sankey proposed a vote of thanks to Sir John Dewrance, and said that when it was found that the expenses of running the research on alloys were growing too big for the Institution, Sir John not only worked hard to secure the balance, but also helped the fund personally. The proposal was seconded by Dr. Hele-Shaw.

In replying to these speeches, Sir John referred to the researches of the Alloys Committee, which, he said, had now progressed so far that they had gone beyond the resources of the makers of refractory materials and electric furnaces. He hinted that if it were possible to get a truly amorphous alloy of iron, stresses as great as 4000 tons per square inch could be borne at temperatures far in excess of those at which present-day materials broke down, and urged that research in this direction should be organised. In connection with these researches, the Institution was, he said, in the proud position of being second only to the Royal Institution in the organisation of research.

This concluded the business of the meeting, which then went on to continue the discussion of Mr. R. W. Wilson's paper on " The Repair and Upkeep of Pneumatic Tools." A report of the first part of the discussion appeared in THE ENGINEER of February 15th.

Mr. J. L. Hodgson (George Kent and Co., Limited) said that the great importance of metering the air used by pneumatic tools had been very forcibly brought home to him when he found that as much as 4 tons of air were used in the gold mines of the Rand for every ton of ore brought to the surface. He had tested a drill which was reported to be in good condition, and found that while it used 50 cubic feet of air per minute when at work, it still consumed 20 cubic feet while idle. He had designed a small meter for measuring such flows, and about 100 of them were put in service on the Rand, with the result that the air consumption of the mines was reduced by 37 per cent., and a money saving of £130,000 was made by the thirteen mines equipped with the meters. The chief difficulty in metering the air used by pneumatic tools was caused by the pulsations of the air in the pipe. Any meter which depended for its action on the flow through an orifice would read fast, as it would show the mean of the pressure differences, rather than the mean of the square roots, which was the quantity required. Mr. Hodgson showed, by means of a diagram—reproduced in Fig. 1—an arrangement for damping out the pulsations. It comprised a measuring orifice O, a throttle T and receiver R, all arranged in series between the main and the tool under test. Referring to Fig. 2, the thick rectangular graph might be supposed to represent the pulsations produced if there were no throttling or receiver capacity, and in these circumstances the meter error would be about 40 per cent. By means of the throttle and receiver, which could be filled with water to vary its capacity, the wave form could be modified, as shown by the dotted lines, with corresponding diminution of the meter error. The error depended upon the factor $\frac{C\,F\,L}{Z\,Q}$, where C was the capacity of the pipe between the tool and orifice, F the frequency of pulsation, L the loss in pressure across the orifice, Z a factor depending on the temperature and pressure of the air, and Q the quantity of air passing. As a consequence, any variation in the frequency, wave form or the quantity would have a very considerable effect on the error of the reading. If, however, the throttling and capacity were increased to such an extent that the error was about 2 or 3 per cent., any change in the conditions would not have such a marked effect, as was shown in the lower graph of Fig. 2.

In view of the fact that the provision of a large receiver would be very inconvenient in underground workings, he had devised the meter shown in Fig. 3, which comprised a light radial gate G that opened a port R as it moved. The gate was deflected by the flow of air against the resistance of a spring S, and the port was so formed that the movement of the gate was proportional to the flow of air. There was a dashpot for damping out pulsations of the gate. Mr. Hodgson said that this meter was only accurate for conditions where the pulsations were less than about 300 per minute, on account of the inertia of the gate. Above that value, the meter tended to read fast, unless throttling and a receiver were resorted to. Mr. Hodgson showed lantern slides of two other metering devices. One, by Mavor and Coulson, is shown in Fig. 4, and comprised a plug valve which was closed until the air pressure caused the weighted piston to rise into sight. The position of the plug valve was then a measure of the rate of flow, but the meter was not, he said, accurate with pulsating flows. The other meter—see Fig. 5—of American origin, had a piston working in a cylinder, whose walls were pierced by a number of equally spaced ports, while there was a dashpot to prevent hunting. This form of meter tended to read fast when measuring pulsating flows, and was liable to stick, on account of grit getting between the piston and the walls of the cylinder. A rotary form of meter was also illus-

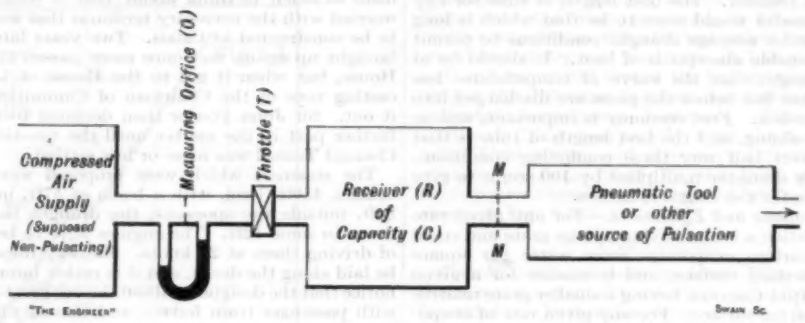


FIG. 1

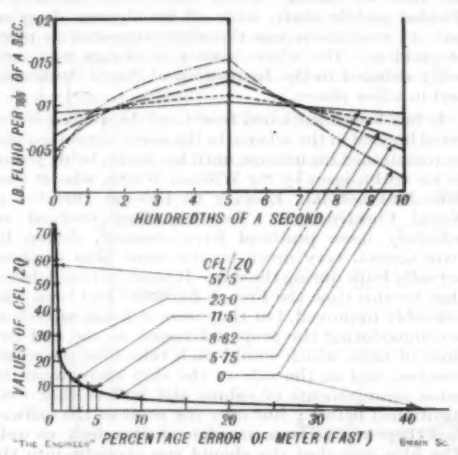
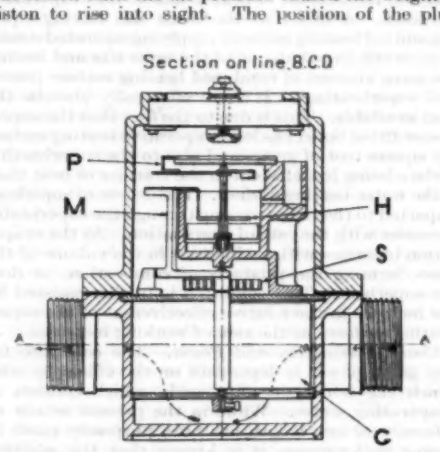
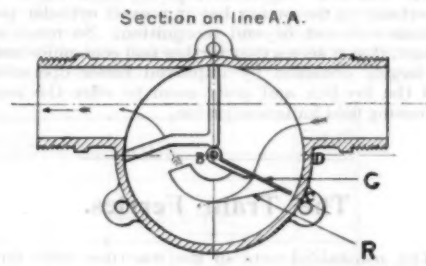


FIG. 2





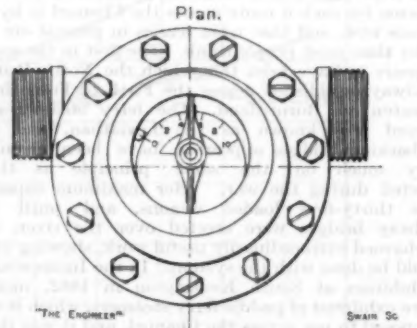


FIG. 3

trated by one of Mr. Hodgson's slides—see Fig. 6. In it a turbine T was acted on by jets from the nozzles N, and its speed checked by the fan F. The speed of the meter was, of course, a measure of the pressure difference across the orifice O, and consequently

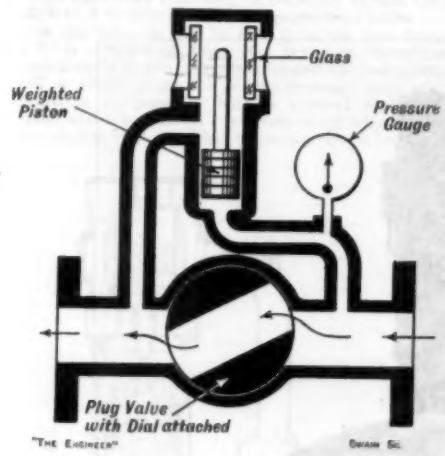


FIG. 4

of the rate of flow. The arrangement was such that the bottom bearing was relieved of part of the rotating weight, and wear was reduced to a minimum. If the meter was overloaded, the valve V shut and protected the turbine from damage. This meter, he said, was accurate down to one-tenth of

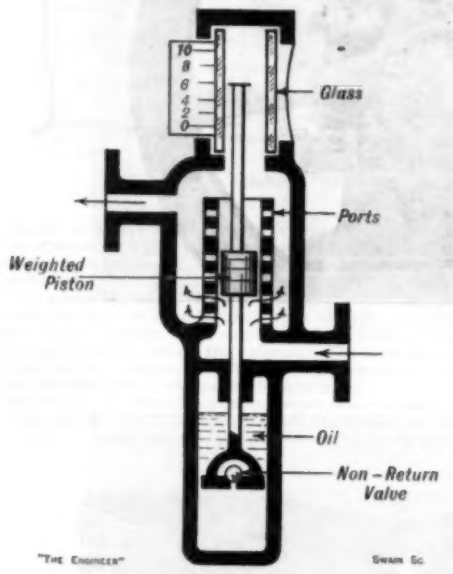


FIG. 5

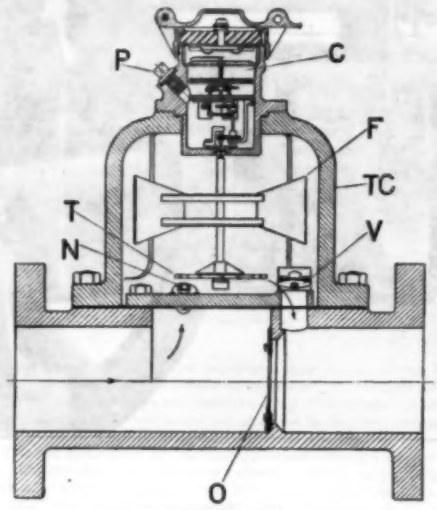
the maximum flow, and had been instrumental in saving 50 tons of coal a week at one Yorkshire colliery.

Mr. Corner and Mr. Brackenbury (C. A. Parsons and Co., Limited) raised objections to the author's system of apportioning the costs of repairs to pneumatic tools, Mr. Brackenbury saying that Mr. Wilson's system would make it appear that he possessed seven watches if he sent one to the watchmakers seven times in one year. He also recommended that all branches should be taken out at the top of overhead mains, turned over, and then brought down to the ground level, in order to avoid trouble through water in the main coming down the branch pipes. There was, however, a tendency nowadays to put the mains underground and thus avoid this trouble. A very simple and effective method of testing a system for leaks was to watch the fall of pressure in the receiver when all the machines were idle during a meal hour.

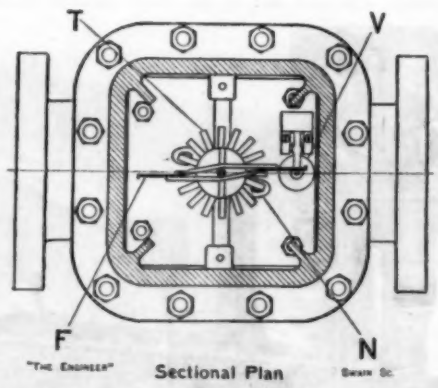
Mr. Herbert Bing said that he thought few firms in this country kept records of the cost of maintaining pneumatic tools in such detail as the author gave in his paper, for which reason the figures were very instructive. They would, however, be of even greater value if Mr. Wilson would supplement them with some particulars as to the capacity and design of the tools. Specially so would this be the case in connection with drilling machines, as, although the four-cylinder type was almost universal, there were considerable differences in the arrangement of details. The designs of hammers did not differ so widely; but even there there was the choice between piston and sleeve valves, while one British maker used flat plate valves. Mr. Bing asked if the author could give any idea as to the life of a pneumatic tool; that was to say, when it should be entirely replaced instead of being repaired. He believed that the practice in America was to renew the tools annually, when they were in constant use. He did not seem altogether to agree with the author as to the difficulty with rivets that are too long. He thought that rivets should, if anything, be left a little long, specially in work with punched holes, as the holes did not register so well as in drilled work. Any excess metal in the head would then be cut off by the snap in closing the rivet, or a countersunk rivet would be left a little proud.

Mr. Symons (Messrs. Reavell and Co.) strongly advocated the simplification of the design of pneumatic hammers in the direction of making them as easy as possible to dismantle. One French make, for instance, had several dowel pins for holding the parts together, and it was very difficult to reassemble the tool without damaging the pins. And if the dowels were bent the joints would not, of course, come together properly. The hammer in question also had a flat-plate valve, which he considered very inefficient. As regards pipe lines, it was naturally most important that they should be kept clean inside; but it was of little use to put strainers in the mains as they would get choked and obstruct the flow of air. The proper place for the strainer was on the tool itself. He thought that the author had underestimated the saving which was effected by increasing the air pressure from 80 lb. to 100 lb. per square inch.

Mr. Macdonald discussed the question of the length of rivets, saying that he thought more work was spoiled by the use of short rivets than by the use of rivets too long. It was essential that the rivet should completely fill the hole, and for this reason



Sectional Elevation



Sectional Plan

FIG. 6

it should be left a little too long; but it was necessary that the rivet should be heated well up to the neck for proper closing. He had known rivets as long as 11in. by 1in. diameter closed with pneumatic hammers.

Mr. Williams also spoke about the length of rivets, but from the point of view of the aircraft manufacturer, who had to rivet together very thin metal. On such work it was very difficult properly to close rivets that were too long, as they bent over under the pressure of the tool. He hoped that the makers of pneumatic tools would produce a multiple riveting head for such purposes. Mr. F. Hills exhibited some curves in connection with his remarks at the previous meeting.

In his reply to the discussion, Mr. Wilson supported his own system of apportioning the costs of repairs on the score of the fact that some machines were used more often than others, so he had based the cost on the number of repairs rather than the number of machines. The amounts given in his table for materials represented the cost of spare parts, while the figures under "the cost of time" covered the labour of dismantling and reassembling. He agreed that the flat-plate type of valve was extravagant of air, as compared with the cylindrical valve, when new; but while wear made a cylindrical valve leaky, the plate valve tended to get tighter with use. The art of closing long rivets was all a matter of choosing the right hammer for the work in hand. If the tool was not up to the job, the rivet would set up outside the hole and then could not be made to fill the hole properly. If the hammer gave a slow and heavy blow it would drive the rivet back, so as to fill the hole better than if it gave light and fast blows. Mr. Wilson agreed with Mr. Symons that the right place to put strainers was at the tool itself, but did not altogether like the arrangement suggested by Mr. Reavell for testing pneumatic picks—see the illustration in our issue of February 15th—as he did not think the spring would recover sufficiently quickly. The style of work referred to by Mr. Williams in connection with aeroplane building had, he said, been successfully done with baby pneumatic tools. Self-closing couplings were not, according to Mr. Wilson, altogether a success, as, although they minimised waste with careless workmen, they tended to throttle the air.

In support of the figures given in the paper as to the cost of compressing air, Mr. Wilson cited a case where the motors driving the compressors consumed 1,751,430 units per year, at a price of 1.09d. The compressors delivered 5200 cubic feet per minute, or 707,000,000 cubic feet a year, which worked out at 21s. 9d. per 100,000 cubic feet, as compared with the 20s. 1d. with power at 1d. per unit, quoted in the paper. Mr. Wilson added that it was good practice to dip pneumatic tools in a paraffin bath, as the air always carried a certain amount of moisture, which was not plain water, but contained some fatty acids from the lubrication of the compressor. This moisture was very corrosive, and he had known it to make the valve of a tool rust up tight in two hours.

Obituary.

WILLIAM A. BOWDEN.

THE Chief Engineer of the Canadian Department of Railways and Canals—Mr. William A. Bowden—died suddenly at Ottawa on February 3rd, at the age of fifty-two years. Mr. Bowden had held the position for fourteen years, and had supervised the construction and operation of many important public works, including the Hudson Bay Railway, the Prince Edward Island Ferry Terminals, the Port Culborne elevator, and the Welland Ship Canal. His more important work was his collaboration with Colonel Wooten, of the United States Government, in the report to the International Joint Commission on the St. Lawrence waterways. Mr. Bowden's long study of, and familiarity with, the problem of the development of the power of the St. Lawrence, concerning which negotiations are now in progress between the Canadian and American Governments, will render his loss deeply felt, and his place difficult to fill.

MINERAL OUTPUT OF SOUTH AFRICA FOR 1923.

THE statistics of the Government Mining Engineer give the value of the mineral output of the Union of South Africa for 1923 as £49,686,061. This is an increase of £13,705,288 compared to the previous year, when it was £35,980,773. The value of gold is calculated at the standard rate of £4.24773 per fine ounce. The Chamber of Mines estimated the value at £4.7 per fine ounce. At the latter rate the total for the year would be £51,054,914.

A comparison between 1922 and 1923, as far as gold is concerned, shows the following:—1922: Fine ounces, 7,009,858; value, £29,775,984; 1923: Fine ounces, 9,143,403; value, £38,838,711.

It must be remembered, however, that at the beginning of 1922 there was the strike, and only a comparatively small quantity of gold was produced during the first three months of the year.

The value of the outputs of other minerals is shown as follows:—Silver, £197,054; osmiridium, £43,528; diamonds, £6,038,207; coal (sales), £3,714,528; copper ore and concentrates, £394,578; iron concentrates and metallic, £174,147; other minerals, £285,350; total, £11,847,350.

Osmiridium is being actively recovered on some of the Rand mines; for it shows an increase of £30,363 and 1,023.6 oz. The advancement of the diamond output is interesting, as it shows there is an improvement in the market, the value of the output having jumped from £2,266,631 to £6,038,207.

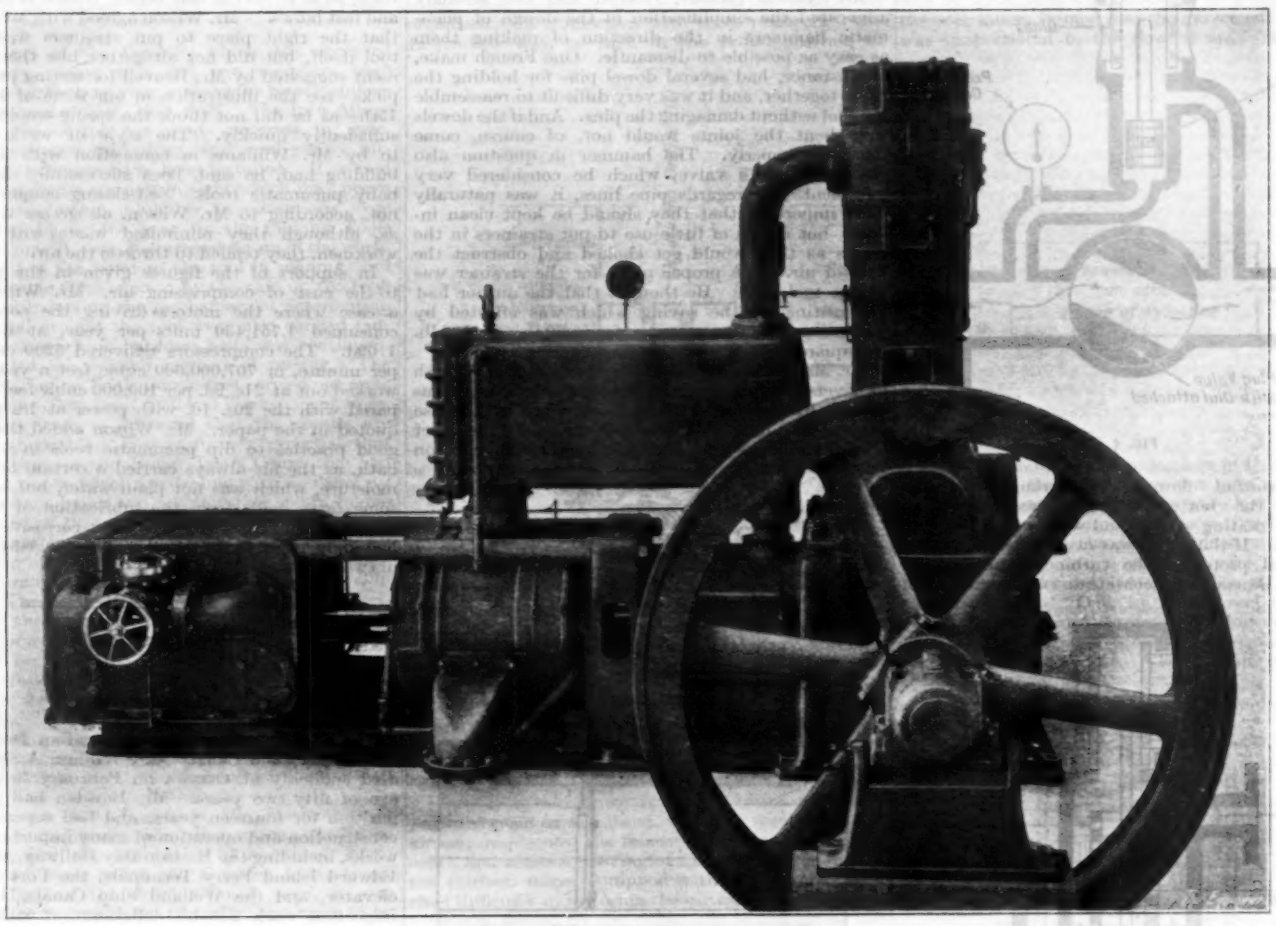
Of the other minerals, lead and asbestos outputs are encouraging. The former shows an increase of £28,497 and asbestos £40,220. Corundum also shows substantial advancement, the increase being £7051.

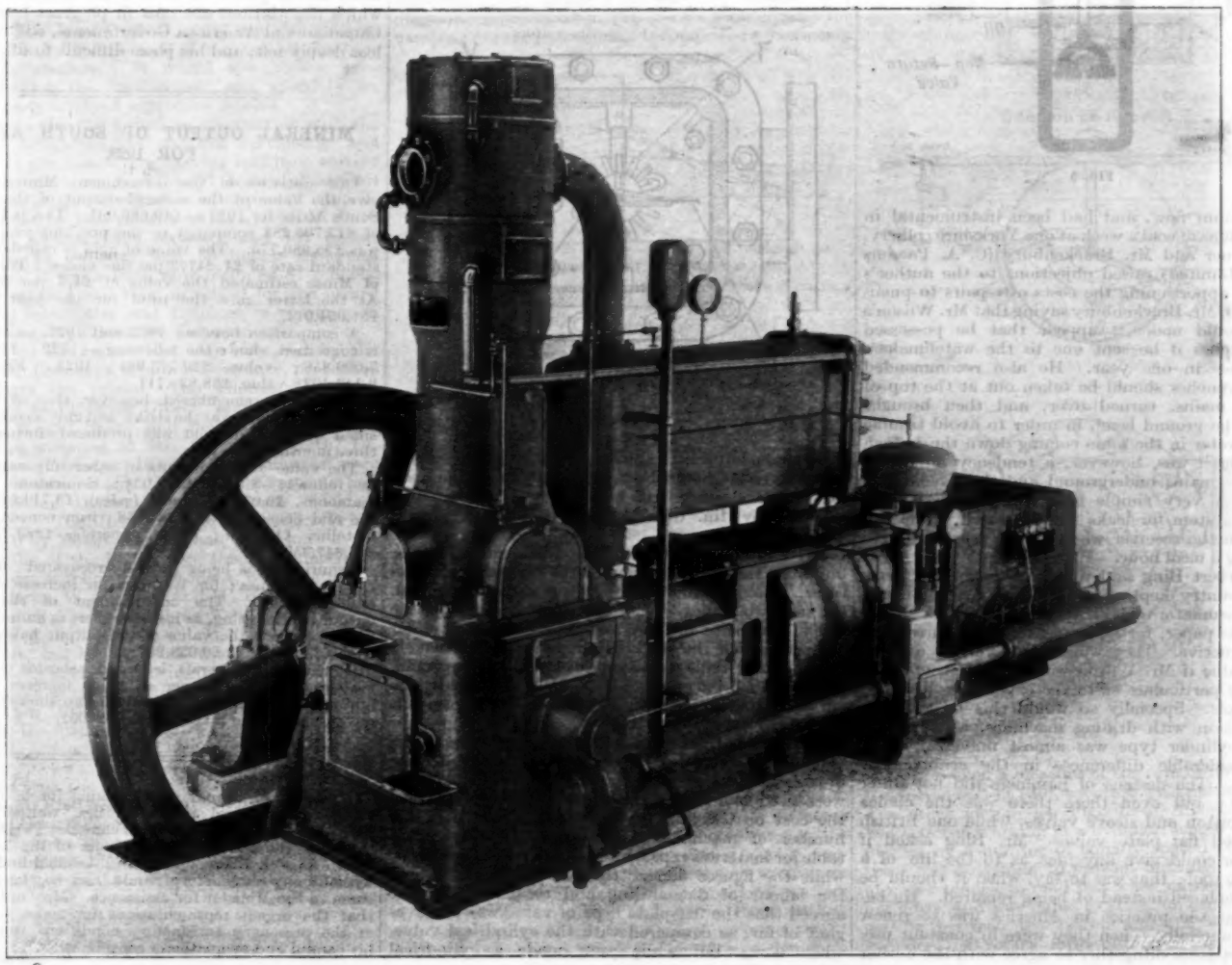
A DEPUTATION from Ilford, asking for better railway communication and train facilities, waited upon the Minister of Transport last Wednesday week. It was said that the chief general manager of the London and North-Eastern Railway and Lord Ashfield had been seen without any satisfactory result, and so the deputation came to the Minister for assistance. Mr. Gosling replied that the urgent representations for some amelioration of the present unsatisfactory conditions would receive his careful and sympathetic consideration.

ANGLE COMPOUND AIR COMPRESSOR

THE SULLIVAN MACHINERY COMPANY, LONDON, ENGINEERS

(*For description see opposite page.*)





An Angle Compound Air Compressor.

A NEW type of air compressor, manufactured by the Sullivan Machinery Company, of Salisbury House, London Wall, E.C. 2, is illustrated by the engravings below.

This machine—as will be seen from the line drawing, Fig. 1—is of the angle type, that is to say, the cylinders are set at right angles in horizontal and vertical positions, round a single crank. The compressing part of the machine is compounded with a vertical high-pressure cylinder and a horizontal low-pressure cylinder, while the steam engine, that provides the motive power, has a single

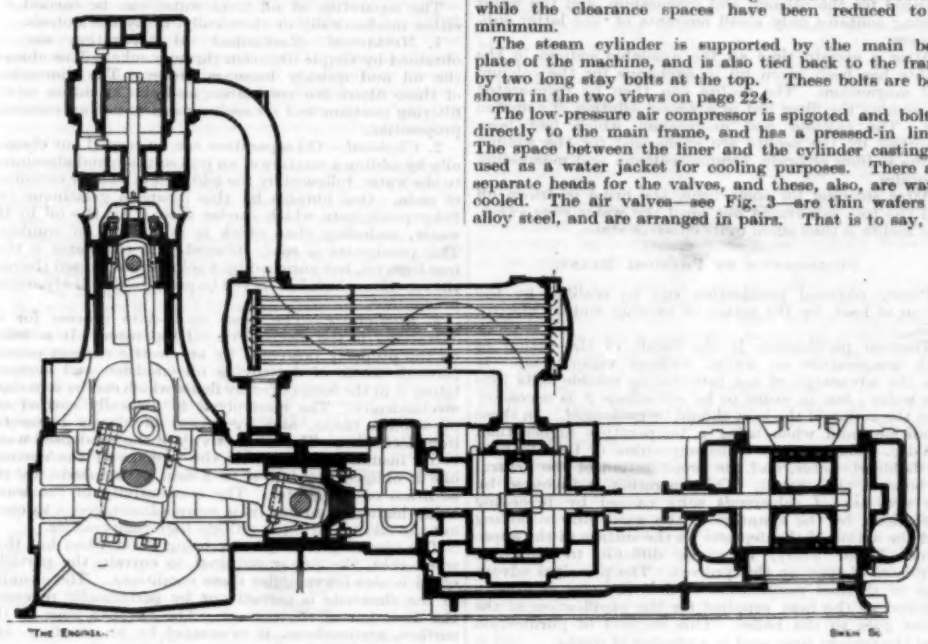


FIG. 1—SECTION THROUGH STEAM AND AIR-COMPRESSING CYLINDERS

cylinder in tandem with the low-pressure compressor. The arrangement provides a compact machine, and also reduces to a minimum fluctuations in the torque on the crank shaft.

The steam engine is, perhaps, the most interesting part of the machine, as it embodies a type of valve not often seen in this country. The engine is of the uniflow class, but has valves to control the exhaust. The arrangement of the valves is shown in Fig. 2, which represents the cylinder with part of the casing broken away.

It will be seen that the cylinder proper is surrounded by a large jacket, which is supplied with live steam, so that the cylinder heads are always at the same temperature as the incoming steam. The inlet valves are, of course, those at the ends of the cylinder and open directly into the steam jacket space. There are two exhaust ports, one for either end of the cylinder, and they are, in turn, overrun by the piston towards the end of its stroke. Exhaust cannot, however, take place until the corresponding exhaust valve has been opened positively.

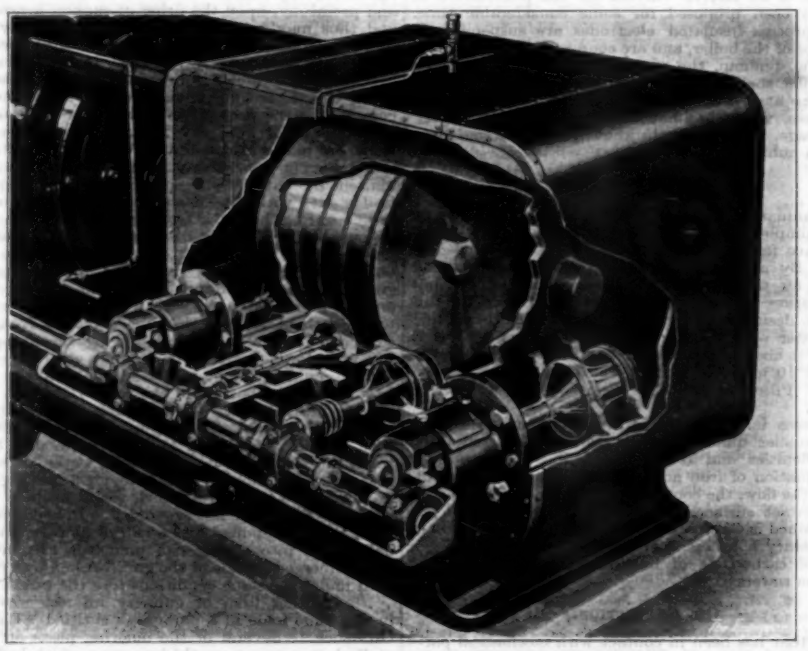


FIG. 2—ARRANGEMENT OF STEAM VALVES

The valves are all thin wafers of tempered alloy steel supported by four-armed spiders. They open against the steam pressure so that they naturally remain tight. A lay shaft running alongside the engine and provided with a set of cams, is used to operate the valves directly, while springs are arranged to keep the rollers up to the cam paths. The result is that although the steam pressure tends to drive the valve discs on to their seats, they cannot hammer on them, as the cams restrain them. In the case of the admission valves there is a stout spring, between the disc and the spider, which tends to keep the valve on its seat. If, however, the compression pressure at the end of the stroke rises too high, through any cause such as high steam pressure or loss of vacuum, this spring will give and allow the excess pressure to escape back into the steam space. This arrangement is not, of course, necessary for the exhaust valves. The valve stems are made steam-tight in their guides by means of a simple form of labyrinth packing. The whole arrangement seems to embody the good features of the uniflow system, and to overcome most of its disadvantages without elaboration, while the clearance spaces have been reduced to a minimum.

The steam cylinder is supported by the main bedplate of the machine, and is also tied back to the frame by two long stay bolts at the top. These bolts are best shown in the two views on page 224.

The low-pressure air compressor is spigoted and bolted directly to the main frame, and has a pressed-in liner. The space between the liner and the cylinder casting is used as a water jacket for cooling purposes. There are separate heads for the valves, and these, also, are water cooled. The air valves—see Fig. 3—are thin wafers of alloy steel, and are arranged in pairs. That is to say, an inlet and an outlet valve are fixed on a single stem, but each valve and its seat can be removed as a single unit. Annular steel springs are used to keep the valves on their seats. The cages are carefully ground to fit their recesses in the cylinder heads and are interchangeable.

The air delivered by the low-pressure cylinder passes to an intercooler, immediately above, which comprises a nest of copper tubes in a cast iron shell, and then goes on to the high-pressure cylinder. This cylinder is of the same general construction as the low-pressure compressor, but naturally is of smaller diameter.

Both the compressing cylinders have bored guides for the crossheads, which are of cast iron with babbitted rubbing faces. The connecting-rods have wedge adjustments for taking up wear at both ends, and the main rod has a keep over the top of the big end in which there is fixed the pin for the high-pressure connecting-rod—as shown in Fig. 1. The main bearings of the crank shaft have to sustain thrusts in two directions at right angles to one another, so they are made in four pieces, of cast iron babbitted. Set-screw adjustments are provided for the several pieces, and the whole bearing can be removed without disturbing the crank shaft. An outboard bearing, it will be noticed from the views on page 224, is provided for the crank shaft, with a heavy fly-wheel inside it.

There are two separate systems of lubrication. One of them is for the main bearings, crossheads and so on, and works on the gravity system. A pump, driven off the cam shaft, raises oil to a tank at the top of the machine, and from that reservoir the oil flows to the various bearings through adjustable sight feeds. The pump delivers slightly more oil than is required by the several services, and the surplus overflows back to the sump at the bottom of the crank case, from which the pump draws.

A separate pump, also driven off the cam shaft, is used for lubricating the cylinders and has six deliveries. Two of these connections go to the two air-compressing cylinders, two others are used for the steam cylinder, and the remaining two deliver oil to the valve bonnets for lubricating the valve stems. The outboard bearing is provided with ring oiling.

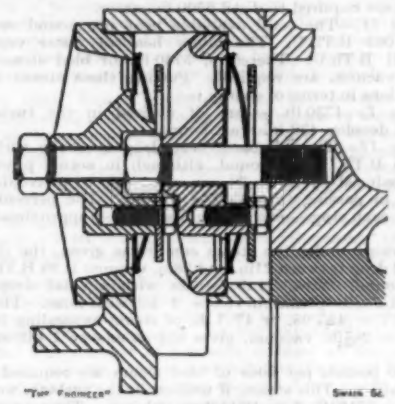


FIG. 3—SECTION THROUGH AIR VALVE

We understand that this air compressor is at present being made in two sizes, having cylinders 20in., 20in., and 12in. by 14in. and 24in., 24in. and 14in. by 16in. The smaller set has a piston displacement volume, for the low-pressure cylinder, of 1138 cubic feet per minute and runs at 225 revolutions per minute, while the larger machine has a displacement volume of 1730 cubic feet per minute, and is intended to run at 210 revolutions per minute.

General Methods of Water Purification for Industrial Purposes.*

By B. HEASTIE.

THE term "water purification" is susceptible of two very different meanings. Purification from a sanitary standpoint may yet leave the water extremely impure from an industrial viewpoint. It is proposed here to deal only with the treatment of water for industrial uses.

Broadly speaking, the methods adopted for the purification of water may be divided into five classifications, which are as follows:—

(1) Distillation.
(2) Removal of suspended matter by filtration.
(3) Water softening by purification.
(4) Water softening by filtration through zeolites.
(5) Use of boiler compounds.

Water which is required for the manufacture of industrial products must be such that the solids they contain do not modify to any appreciable degree the nature or the quality of the finished product. The conditions vary in each industry. However, absolutely pure water is very rarely necessary, and it is generally sufficient to eliminate the deleterious elements.

The subject of most general interest is the treatment of water for boiler-feed purposes. The tendency to-day is toward boilers of very large capacity, and high pressures, often working at 200 per cent. to 300 per cent. of their normal rating. The introduction of hard water into such boilers causes hard scaling on the whole of the heating surface in contact with the water.

PURIFICATION BY DISTILLATION.

The ideal boiler feed is distilled water, as obtained by evaporation and condensation of natural water free from air. It is carried out on a large scale in electrical power stations where one can see most clearly the deleterious effects of bad water feed, and where efficiency is a first consideration, a small variation resulting in a profit or loss.

The economical production of distilled water in power stations is dependent upon the fact that the main object of the station is to produce work from heat; to this end, heat is generated at a high temperature and converted into heat at a low temperature doing mechanical work in the conversion. Thus heat has a certain commercial value dependent upon its temperature or thermo-dynamic head. When heat is exchanged between two bodies, it is essential that the transference should be carried out with a minimum temperature difference.

Let us consider a station in which steam is supplied to a 10,000-kilowatt turbine at 260 lb. per square inch absolute, superheated 250 deg. Fah., and exhausting to the condenser at 28.5in. mercury. The total adiabatic heat drop is about 425 B.Th.U. per pound, or assuming 77 per cent. thermal efficiency actually 326 B.Th.U. per pound. The steam consumption on full load would be about 11 lb. per kilowatt-hour, or 110,000 lb., assuming 5 per cent. make-up water is required, 5500 lb. of water must be distilled per hour.

Compare the two cases given below.

(1) A single effect evaporator using steam at boiler pressure 260 lb. per square inch also superheated 250 deg.

* Paper read at a joint meeting of the Institution of Mechanical Engineers and the Chemical Engineering Group of the Society of Chemical Industry.—Abstract.

Fah, the distilled water vapour passing to the condenser at 28½in. vacuum.

(2) A single effect evaporator using low-grade steam bled from the turbine at 21in. vacuum (157 deg. Fah.), the distilled water vapour passing to the condenser at 28½in. vacuum (90 deg. Fah.).

In order to make a fair comparison, assume that in both cases the condensed steam leaves the evaporator shell at 157 deg. Fah.

Case I.—The available heat per pound of steam is :—1210 B.Th.U. per pound. The latent heat of water vapour at 28½in. vacuum (90 deg. Fah). is 1041 B.Th.U. per pound. Therefore, neglecting radiation losses, 4730 lb. steam are required to distil 5500 lb. water.

Case II.—The total available heat per pound steam is :—1003 B.Th.U. The latent heat of water vapour is 1041 B.Th.U. Therefore, 5740 lb. of bled steam at 21in. vacuum are required. Putting these steam consumptions in terms of energy :—

Case I.—4730 lb. steam, if utilised in the turbine, would develop 430 kilowatt-hours.

Case II.—The adiabatic heat drop over the turbine is 425 B.Th.U. per pound, although in actual practice it is reduced by 20 to 30 per cent., due to unavoidable losses in passing through the turbine. The percentage loss in each stage—except the first one—is approximately equal.

Working under the steam conditions given, the theoretical drop between 21in. and 28in. vacuum is 98 B.Th.U. per pound. Now, 11 lb. steam with a total drop of 425 B.Th.U. pound develops 1 kilowatt-hour. Therefore, 11 × 425/98, or 47.7 lb. of steam expanding from 21in. to 28½in. vacuum, gives out as energy 1 kilowatt-hour.

5740 pounds per hour of bled steam are required for distillation. This steam, if utilised in the turbine, would develop 5740/47.7, or 120 kilowatt-hours. Thus a saving is effected of 310 kilowatt-hours by using low-grade steam. Basing upon a coal consumption of 1.8 lb. per kilowatt-hour, the saving effected would be 6 tons per 24 hours. Or assuming a load factor of 50 per cent. and coal at £1 per ton, the annual saving would be £1100.

Purification by Chemical Means.

When applied to boiler feed water chemical methods of purification aim at removing from the water the calcareous salts which it contains, and which—decomposing in the boilers—cause scale to be deposited.

These salts can be divided into two categories : carbonates and non-carbonates.

(1) In the first category belong almost all the salts in the most common waters ; bicarbonates of calcium and magnesium are the most important. In the usual process of purification, they are eliminated :—

(*a*) By the addition of barytes or caustic lime.
(*b*) By the addition of caustic soda.
(*c*) By the addition of carbonate of soda (solvay soda).

In all these cases insoluble calcium or magnesium carbonate is precipitated, and the water fed to the boilers is always alkaline.

(2) In the second category are a great number of salts, of which we may mention sulphate of lime and chloride of magnesium. Chloride of sodium cannot be eliminted by practicable chemical methods from any water. Carbonate of soda or caustic soda removes sulphate of lime and chloride of magnesium. During these changes the reactions are not quantitative ; they give rise to a state of equilibrium and to move this equilibrium in the favourable direction—that is to say, in the direction giving the desired precipitate—one is obliged to introduce an excess of the precipitating reagent. The water introduced in the boiler is then, in all cases, alkaline and contains carbonate of soda.

Effect of Temperature on Chemical Methods.

It is advisable to carry out purification at a high temperature, for the following reasons :—

(1) Gases in solution in the water are driven off by increasing temperature.
(2) Increased speed of reactions.
(3) Precipitation of the salts is much quicker at higher temperatures.
(4) Above 160 deg. Fah. the bicarbonates of the alkaline earths begin to decompose giving carbon dioxide and the carbonate.
(5) Diminution of the solubility of calcium sulphate (10 per cent. diminution between 60 deg. Fah. and 180 deg. Fah.) and a consequent precipitation of part of this salt without any reagent.

Continuous Blowdown.

When a boiler, in which the water has been purified by some means, has been working for some time all the salts contained in the purified water are concentrated. These salts are alkaline salts only when the water is perfectly purified, but are calcareous muds when purification is incomplete. Generally, there remains in solution in the water from 30 to 60 mgs. per litre of calcium carbonate. When concentration produced by evaporation becomes sufficient for precipitation of the carbonate in spite of the high temperature, it is deposited on the walls of the boiler and the tubes, forming incrustations, which become harder the slower the rate of deposition. To avoid this, the boiler is blown down, thus removing the mud collected. This water is at the pressure and temperature of the boiler and, in blowing down, a large amount of heat is lost, as, in order to be effective, the blowing down should be of considerable volume in proportion to the total volume of the boiler. In the Kestner system, which is in extensive use on the Continent, instead of sending to waste a large quantity of water, a small amount is continuously blown down ; this cools, at the same time giving up heat to the feed water in the purifier. It loses on cooling a certain amount of the dissolved salts, and these muds are deposited in a settling vessel. It then mixes with the feed water and returns to the boiler. The removal of the muds deposited by the blowdown is carried out quite easily, as precipitation takes place in a vessel of conical form. When a boiler is blown down—*e.g.*, using 20 per cent. of the feed water—its contents will be renewed every five hours; this cannot be done by any other method which ensures elimination of the muds before they have time to accumulate. A constant salt content also is maintained in the boiler, and the amount of soda to be added to the water is greatly reduced.

Zeolite Softeners.

This type consists of a filter, the bed of which is usually composed of a hydrated silicate of aluminium carrying a large amount of loosely-bound and chemically active sodium.

When water containing calcium and magnesium salts is passed through this bed of zeolite, the sodium is exchanged for the calcium and magnesium, and the water leaving contains only small amounts of the latter substances.

After a certain time all the available sodium in the zeolite has been given up in exchange for the calcium and magnesium. The zeolite can then be regenerated by soaking the filter bed in a strong solution of common salt. The calcium and magnesium which had been absorbed by the zeolite are exchanged for the sodium of the sodium chloride, forming calcium and magnesium chlorides.

After steeping for some time, the brine is drawn off and the free salt rinsed out until the water runs sweet. The zeolite is then again in its effective state.

Purification by Physical Means.

Purely physical purification can be realised by the action of heat, by the action of vacuum and by electrolysis.

Thermal purification is the result of the action of high temperature on water, without vaporisation. It has the advantage of not introducing soluble salts into the water ; but in order to be efficacious it is necessary that the action of the heat should be prolonged. In these conditions and when using a temperature higher than 158 deg. Fah. one gets a decomposition of the alkaline-earth bicarbonates, and the precipitation of the neutral carbonates as a result. This operation is favoured by the presence of calcareous salts caused by preceding operations, by the agitation of the water due to boiling and the action of the deposits on the surface of the apparatus. Theoretically, it seems difficult to eliminate sulphates of lime by this process. The principal advantage of thermal purification is that the cost is greatly reduced as the heat supplied for the purification of the water goes to the boiler. This method of purification is at the present time used in a number of works.

"Purification by vacuum" is effected in certain processes of water de-aeration ; it would not be economical if it were required only for this purpose. It is carried out as follows :—The water is discharged in the form of fine spray into a space where there is a high vacuum. The water is thus carried to boiling point in a manner which is nearly explosive, the vapour and the gas from the water being then eliminated by means of a vacuum pump. The water which is not vaporised gathers in the bottom of the apparatus from which it is taken by an extraction pump.

Due to the reduction of pressure, a dissociation of the bicarbonates takes place, and the carbonate of lime is precipitated and may be separated by filtration. This process is only of interest if one wishes to de-aerate the water by vacuum, as its action is limited to the elimination of the carbonates.

The use of an electric current for the purification of water has been proposed for some considerable time. In this process insulated electrodes are suspended in the interior of the boiler, and are connected to the positive pole of the dynamo, the negative pole being connected to the boiler shell. The current used is of the order of one ampère at a pressure of 6–12 volts. The results of this process, which has not completely left the experimental stage, are very little known, as no actual data have been published.

Elimination of Iron.

The elimination of iron from water may be done by a very simple method. The ferrous salts are transformed into ferric salts by the action of the oxygen in the air. By allowing the water to remain in contact with the air one precipitates the iron as "rust," but this oxidation is slow and incomplete. Plants for this work are designed to encourage an intimate contact of the water with the air, based on the fact that it is necessary to absorb by the water 1 c.c of oxygen in order to transform 10 mgm. of ferrous iron into the ferric combination. Filtration is always necessary after the action of the air.

Manganese in solution in water as manganese salts, but in smaller quantities than the iron, presents the same difficulties and is eliminated in the same way. The elimination of iron not only takes out the iron, but, owing to the flow, the contact with the air, and the action of the contact surfaces, a part of the carbonic acid gas half combined is eliminated, which causes a diminution of the temporary hardness, and at the same time causing a deposit of carbonates of lime and magnesium in the absorption towers.

Oil Extraction.

Water that has been in contact with mechanical parts of engines or exhaust steam from engines, is polluted by a mixture of small quantities of lubricants. The oil is not only mixed with the water, but is also in the water in emulsion, so that a simple decantation only enables one to eliminate the drops which float on the surface, and does not eliminate the oil in emulsion ; therefore, the water remains opalescent. The quantities to be dealt with are generally small, usually a few centigrammes of oil per litre of water. Sometimes there are larger quantities, but that is due to bad or excessive oiling, and can be remedied. But whatever quantity of oil is in the water, it is increased in the boiler owing to concentration, and the oil adheres to the walls and diminishes considerably the coefficient of heat transmission. A layer of $^1/_{25}$in. thick in a boiler working at 150 lb. square inch pressure will increase the wall temperature by 360 deg. Fah.

When the water is slightly alkaline there is a formation of froth and an entrainment of water. Finally, the oil mixed with the muds produces an insulating mixture which causes intense superheating and a decomposition of the oil, and also forms an organic body which is corrosive and attacks the steel plate. It is therefore necessary to eliminate oil from the water. This can be carried out either on the vapour which contains the oil before condensation, or on the water itself.

The separation of oil from the vapour is carried out in apparatus fitted with baffles on which the jet of vapour is broken, thus depositing its oil, or in apparatus where the vapour circulates at a great speed in a helicoidal space. The drops of oil are projected towards the outside by centrifugal force, where they accumulate and are then extracted.

The separation of oil from water can be carried out either mechanically or chemically, or by electrolysis.

1. *Mechanical.*—Mechanical oil separation can be obtained by simple filtration through coke. This absorbs the oil and quickly becomes greasy. The dimensions of these filters are very large, and the attention to the filtering medium and its replacement is not an economic proposition.

2. *Chemical.*—Oil separation can be carried out chemically by adding a mixture of an iron solution and aluminium to the water, followed by the addition of soda or carbonate of soda. One obtains by this means a gelatinous and flaky precipitate which carries with it all the oil in the water, including that which is in a state of emulsion. This precipitate is easily filtered, and the water is then free from oil, but enriched by a soluble salt caused through the reaction which has served to produce the oil-separating precipitate.

3. *Electrolysis.*—The most up-to-date process for oil extracting is the electrolytic oil separator. It is based on the property possessed by an electric current passing through water of destroying oil emulsion and accumulating it in the form of frothy flakes which can be separated mechanically. The electrolysis is generally carried out in wooden tanks, and by means of closely connected iron electrodes. The conductivity of the condensed water being insufficient to enable the passage of the current, one is obliged to carry it to 3 deg. hydrometric, by the addition of raw water. The conductivity of the water being higher when hot, it is more advantageous to carry out the oil separation at a fairly high temperature.

The viscosity of the water being lower when hot than when cold, the power required to entrain the particles of oil is also lower under these conditions. The cleaning of the electrode is carried out by periodically reversing the direction of the current. The oil then rises to the surface, accumulates, is evacuated by an overflow, and the water which has been separated from the oil is carefully filtered.

The current required is valued at 0.15 to 0.20-kilowatt per ton of water treated.

SIXTY YEARS AGO.

It is well known that Robert Fulton devoted considerable thought to the construction of craft of the type which we now term submarines, and that he laid plans before Napoleon whereby he proposed that French soldiers should be transported in such vessels across the Channel for the purpose of invading this country. It may not, however, be equally well known that Fulton conducted experiments which were regarded as successful and promising, upon the firing of cannon beneath water, and thus may be held to be one of the early pioneers of the torpedo. Submarine firing was attracting considerable attention sixty years ago for, with the armouring of naval vessels, it became recognised that attack below the water line provided a hopeful method of circumventing the protection afforded by the iron plating. In our issue of February 26th, 1864, we gave extracts from an unspecified account describing Fulton's submarine firing experiments. Fulton, it seems, satisfied himself by calculations—based on assumptions which to-day we, with our knowledge of stream-line motion must regard as being far from correct—that the resistance encountered by a body discharged beneath water would not be excessively great. He then proceeded to carry out experiments in the river Hudson. A four-pounder gun, with its breech end enclosed in a water-tight box and its muzzle stopped with a tompion was submerged to a depth of 3ft. A tin tube extended from the box to above the water surface, and by the dropping of a live coal down this tube on to the vent of the gun, the charge could be fired. On trial the ball was found to have struck the bottom of the river 41ft. away from the muzzle of the gun. The gun itself was uninjured, a fact which apparently encouraged Fulton to proceed with his idea of placing guns on a warship below the water line with their muzzles in the water. He proposed that the guns should recoil through a stuffing-box, and be provided with valves which would exclude the water when the guns were not protruded. In his second experiment he used 9 pound and a-half of powder, and sent his ball 11½in. into a target of pine logs 12ft. away from the submerged muzzle of the gun. A hundred pound ball fired under the same conditions tore the target to pieces. . . . Another item of gunnery interest was recorded in the same issue in a paragraph entitled "Early Rifled Ordnance." Several of the mooring posts on the quay at Peel, it seems, were old iron guns which had formerly been mounted in Peel Castle. Following the reports of some visitors, the guns at the instance of the War Office, were examined by competent authorities and were pronounced to be the earliest specimens of rifled cannon known to exist. The old cannon, eight in number, were replaced by other guns of less historical interest, and six were shipped to the museum at Woolwich Arsenal, two being allowed to remain in the Isle of Man.

It is reported from Toronto that the Ontario Government is introducing legislation providing a bounty on iron ore of ½ cent per unit of 100 lb. on the condition that a like bounty is contributed by the Federal Government. A further measure provides for the taxation of nickel and copper mines on a profits basis.

Railway Matters.

IT is reported that the contract for the 125 miles of three-core high-tension cable required for the electrification of the South-Eastern section has been given by the Southern Railway to Messrs. Johnson and Phillips.

ALL the bridges on the Great Southern and Western Railway, which were so seriously damaged during 1922, have, with one exception, been restored. Practically the whole of the malicious injury done on the Great Northern of Ireland has also been made good.

IN an address at Montreal recently Sir Henry Thornton, President of the Canadian National Railways, said that with average good luck the system in three years' time should cease to be a burden to the Canadian taxpayer, and in ten years it would be second to no railway system in the world. Canada's greatest need was immigration. "If we had twenty-five millions," he said, "in this country instead of nine there would be no railway problem to-day."

THE Belgian Government is taking energetic measures to end the disorganisation of the State railways. A Director-General of Railways has been selected from the ranks of private industry, and has been given a free hand. Sixty-two officials of various grades have been removed from the railway service by Royal decree before reaching the age of retirement. This report lends point to some comments as to the Belgian railways made in the leading article on State railways in THE ENGINEER of October 5th last.

THE annual report of the Institution of Railway Signal Engineers shows that 76 "home" and 21 "overseas" members were elected last year; that one overseas member died and seven home members resigned, and that on December 31st last there were 392 "home" and 131 "overseas" members—a total of 523. The Institution has been presented with the library of books possessed by the Association of Railway Companies' Signal Superintendents and Signal Engineers on the latter body ceasing to exist.

IN the Great Western annual report, just issued, it is announced that "Mr. W. W. Grierson, C.B.E., chief engineer of the company, retired at the close of last year, having been in the service since 1887. The directors desire to place on record their high appreciation of the valuable services which Mr. Grierson has rendered to the company and of the able manner in which he has discharged the important and responsible duties of his office. The company will continue to have the benefit of his experience and knowledge as consulting engineer."

THE Port Augusta-Oodnadatta Railway was built by the Australia Federal Government, and was completed before the east-west trancontinental line—also Federal-owned. As at that time there was no organisation for working these railways the Oodnadatta Railway was given to the South Australian Government to operate, the Federal authorities agreeing to recoup all losses in working. When the transcontinental line was nearly completed a railway department, under Mr. Norris G. Bell, was organised, and it is now proposed to cancel the Oodnadatta agreement with the South Australian Government.

A SUBSIDENCE of the London and North-Eastern Railway between Ferryhill and Bishop's Auckland, owing to coal workings, occurred near Byers Green last week. The sleepers and rails were left suspended in the air. This branch had a dramatic beginning. The powers for its construction expired on March 31st, 1837, and there seemed every probability that, owing to lack of financial support, they would lapse. Sufficient money was, however, found to run a temporary road over the route and to convey some wagons by horses and thus to meet the Act. The line was not, however, opened properly for another four years.

THE Ballycastle Railway runs from Ballymoney, in the Northern Counties Section (Ireland) of the Midland Railway to the harbour of Ballycastle on the Antrim coast. It is 16¼ miles long, of 3ft. gauge, and was opened in October, 1880. It has now fallen on evil days and, whilst not bankrupt, cannot see its way to carry on. The Ministry of Transport and the Parliament of Northern Ireland have been approached as to assistance, but the former has replied that it no longer has anything to do with any Irish railways, and the latter does not regard the matter as one in its charge. The shareholders have, therefore, met and authorised the directors to dispose of the railway to the best advantage.

NEXT to Burton-on-Trent—where the streets abound with crossings of railway lines giving communication with the various breweries—Hull would seem to be the most handicapped city in this manner. Inquiries show that it would cost a million pounds to replace these crossings by over or under-bridges, but if only the crossings in the western portion of the city were dealt with the cost would be £750,000. The Hull Corporation has approached the London and North-Eastern Railway on the matter. These crossings, we would point out, are there by right, and the only benefit the railway company would obtain by their abolition would be the saving of the wages of the crossing-keepers. The city would be the gainer, as the gates are closed for about 250 minutes every day.

DURING the three months ended June 30th last the assistant inspecting officers of the Ministry of Transport held 25 inquiries into accidents to railway servants. Seven of them related to fatal accidents, which involved the death of 8 men, of which all but two occurred to men working on the track. In one of the seven accidents a fireman went, whilst the engine was in motion, on to the coal at the back of the tender and his head was struck by an overbridge. The driver did not know his mate had left the footplate nor why. The rule is that neither enginemen must do this unless it is absolutely necessary to do so. As there is an objection to making the rule more definite, the report suggests that a rider be added that when the necessity arises an engineman shall only leave the footplate after agreement with his mate in order that both men may be aware of the risks to be guarded against.

Notes and Memoranda.

THE Council of the Royal Agricultural Society of England announced, at a recent meeting, that it had decided to renew its field trials of suitable implements. The University of Oxford will work in conjunction with the Ministry of Agriculture, and intends to set up a Research Institute for the purpose of dealing with problems connected with agricultural machinery.

THE Geological Committee has completed its work in connection with the investigation of mineral deposits in various parts of the Ukraine. In many places new beds of iron and manganese ore have been discovered. In the Krivoi Rog basin, in particular, an extensive bed of iron quartzite has been found, and in the Kheshtshevatski district (Government of Podolia) a deposit of manganese ore 35ft. thick over an extensive area.

SAMPLES of various "normal" and "abnormal" steels submitted to the American Bureau of Standards by different manufacturers have been carburised and examined microscopically. The structural characteristics of these carburised steels confirm the contention that there is a difference in the carburising properties of steels which show but little difference in their composition as ordinarily determined. These differences consist in variations in the average depth of penetration, as well as in the character of the pearlite.

IN field tests of liquid oxygen explosives, recently made in Colorado by the American Bureau of Mines, various types of cartridges have been tried out in drift rounds. Sensitised lampblack cartridges broke well in the hardest ground. Keiselguhr-oil mixtures of lower rate of detonation broke well in the ore, but not in the harder limestone. Coal-dust mixtures broke well in ore. A cheap grade of carbon black gave a perfect break. It is evident that for medium hard ground a very cheap cartridge may be employed.

IN view of statements recently made as to the possibility of the communication of infectious diseases through the medium of the public telephone, the Postmaster-General reminds the public that past investigations here and in America show that the real risk of such infections is negligible. An eminent bacteriologist has conducted experiments, the results of which confirm this view; also a regular staff of cleaners attend to the transmitter mouthpieces and receiver ear-cups, and disinfect them, at regular intervals of three days. So another bogey is laid.

SUCCESSFUL experiments in the production on a large scale of the new rustless iron invented by the Aktiebolaget Ferrolegeringar at Trollhaettan have, it is reported, been made by the Klosters Aktiebolag. It is stated that the experiments show that the iron can be made rustless without losing other important qualities, and that it can be manufactured at prices which render its practical use economical. The alloy in question is called Ferro-chrome, and it is understood that it is manufactured from Swedish iron ore mixed with ore imported from South Africa.

THE consumption of coal and coke in Lithuania is very limited. No coalfields have as yet been discovered in the country; wood is used for all general heating purposes, and most of the power stations depend upon peat for their fuel. Only from 55,000 to 60,000 metric tons of coal are imported annually. The Government railways consume about 50,000 tons, and the remainder is used by various manufacturers. Practically all of the coal imported comes from England by way of the new Lithuanian port of Memel, and is then distributed by the Government railways.

THE new railway bridge, which is to be built over the Murray River in South Australia, is to be entirely of steel, and to carry a single track, capable of bearing the heaviest locomotive and wagons. The bridge, for which £250,000 has been provided on the loan estimates, will consist of three main spans, one being 240ft. long, and the other two each of 145ft., to carry the structure over a reclaimed swamp area, as well as the river proper. Seventeen steel trusses, each of 70ft., will be used. The bridge will be built immediately down stream, and about four chains from the present overway. Its foundations will be upon solid granite, which has been found by borings to be a depth of 79ft. to 83ft.

IN an article on economical uses of alloy steel, in *Brown Bayley's Journal*, reference is made to the valve stems of high-pressure steam engines in which, as in the majority of cases nowadays, expensive metallic packing glands are used. These metallic packings are sold at a price per inch of diameter, or fraction thereof, and it might well be that a reduction in the diameter of the valve spindles and piston-rods of a high-pressure engine, obtained by the use of alloy steels, would be compensated for in the reduced price of the metallic packings alone. The saving, however, would not stop there, for the leakage round a packed rod is, roughly, proportionate to its diameter, and both economy in steam consumption and in reduced loss of vacuum would probably result from a reduction in diameter of gland.

LECTURING before the Society of Arts on February 20th, Mr. P. J. Burgess said that the steel or iron linings of the tubular vessels containing heavy iron balls, used in crushing and grinding mills, had been advantageously replaced by rubber. Not only did this resist wear better, but grinding took place more perfectly. This result was due to the rubber walls of the revolving mill gripping the balls better, lifting them higher without slipping, and letting them fall with greater effect on the surfaces to be pulverised. Industrially, rubber was still essentially an accessory—as, for example, in the air brake tubing of a train, the washer in the tap, the cushion of the billiard table. What the rubber-producing industry needed was a use for rubber on a large scale at some pivotal price, such as 1s. 6d. per pound. That use would not be found in the trade in small rubber sundries, such as acorns for window blinds, or stops for doors. Tires, consuming seven-tenths of all the rubber produced, were made and worn away with little reference to the balance of supplies of rubber or oil. The solution of the problem might be found in paving the streets with rubber.

Miscellanea.

THE referendum in Switzerland on the law authorising the prolongation of the working hours in the factories from 48 to 54 hours a week at a time of crisis has resulted in the rejection of the proposal by 430,000 votes to 312,000. Over 80 per cent. of the people voted. In the Neuchatel district the voting against the measure was 17,000 to 8000, and at Geneva, 16,000 to 6000.

A CABLEGRAM from Wellington, New Zealand, reports that after two years and four months work the big tunnel, which is to convey that town's new water supply, was successfully pierced on Saturday last. The tunnel had to penetrate two miles of rock through a range of hills 2500ft. high. The work was carried out by co-operative labour, and there were no accidents throughout the whole period.

IN 1923, France imported from her colonies 3071 million francs worth of goods and exported to them 4069 million francs worth, showing an increase of 863 millions with regard to imports, as compared with 1922, and 948 millions with regard to exports. French imports from foreign countries during 1923 amounted to 29,536 millions, and exports to foreign countries to 26,361 millions, or a total trade of 55,897 millions. The total trade with the colonies—7140 millions—represents, therefore, roughly 11 per cent. of France's commercial activity abroad.

THE return of the National Federation of Iron and Steel Manufacturers show that the production of pig iron in January amounted to 631,500 tons, compared with 626,900 tons in December and 567,900 tons in January, 1923. The number of furnaces in blast at the end of January was 189, compared with 204 at the end of December, 15 furnaces having been damped down owing to the railway strike. The production includes 210,800 tons of hematite, 213,000 tons of basic, 142,300 tons of foundry, and 34,400 tons of forge pig iron. The output of steel ingots and castings increased from 653,300 tons in December to 690,100 tons in January.

IN order to demonstrate to the Australian public the keenness of British manufacturers to supply their requirements in motor transport of all kinds, an "All British" Motor, Motor Cycle and Accessories Exhibition is to be held in July, 1924, in Melbourne, by the Association of British Motor Manufacturers, Limited, in conjunction with the British Cycle and Motor Cycle Manufacturers and Traders Union, and the Australian Association of British Manufacturers and their representatives. The Exhibition will include motor cars, commercial vehicles, motor cycles, cycles, and accessories, and is being supported by a very large number of leading manufacturers in each branch.

THE official bench trials of the two 450 brake horse-power direct reversing marine engines, built to the order of J. Samuel White and Co., Limited, of Cowes, for two tugs which that firm is now building for the Egyptian Ports and Lights Authorities, recently took place at the Ipswich works of Vickers, Petters, Limited. Each engine was run at full load for 6 hours and then at reduced speeds, the minimum speed being from 54 to 60 revolutions per minute, the engines running quite steadily at these low speeds. Reversing was effected in 4 sec. to 5 sec. After the machinery has been installed at Cowes and official trials run, the tugs will proceed to Egypt under their own power.

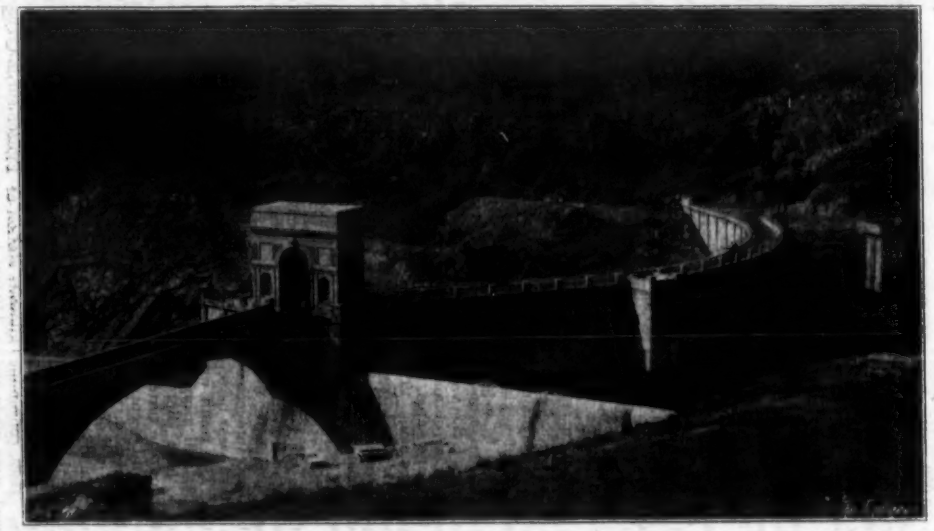
THE new ferry-boat train service between Harwich and Zeebrugge has recently been opened. The company exploiting the new service is an Anglo-Belgian concern with a capital of £100,000. The ferry boats are British, and the trains are Belgian. The through service will be maintained with trains to Italy, Switzerland and Czecho-Slovakia. "The Great Eastern Train Ferries, Limited," as the new concern is called, will work with the London and North-Eastern Railway, and with the Belgian State Railways. All goods will be shipped to distant parts of the Continent without any reloading. This saves time, and cuts down the risk of loss and damage *en route*. The power for the ferry boats will be provided by heavy oil engines.

THE town of Sofia is suffering from a lack of water, especially in summer and winter, when the supply, which at other times averages 95 litres per head for the 24 hours, is reduced to 30 litres. In order to remedy this defective supply the Sofia Town Council is studying the question of bringing water from the lakes in the Rilo mountains. It is estimated that the execution of the work would take something like five years and the outlay would approximate 500 million leva. As there is a considerable difference in the level between the Rilo lakes and Sofia, two falls, of 300 m. to 400 m. respectively, would be taken advantage of for the installation of two electrical plants capable of developing 11,000 to 16,000 horse-power respectively. An American company has made an offer to the Town Council to undertake the work and provide the capital. A commission of engineers and economists has been appointed to consider the American offer and the general question of the town's supply of water.

AT an informal meeting of the Institution of Electrical Engineers, held on February 18th, Mr. E. M. Malek opened a discussion on "Electrical Developments in France." During the course of his remarks, Mr. Malek explained that the amount of water power available was 9,000,000 horse-power, and that by 1925 one-third of that amount would be utilised. In ten years time 4,000,000 horse-power would be employed, representing a saving of 24,000,000 tons of coal per annum. At the present time there were eighty-two power-houses in France. Two of these stations had capacities of over 100,000 kilowatts. The Gennevilliers station contained plant capable of developing 200,000 kilowatts, but its ultimate capacity would be 400,000 kilowatts. It was proposed to interconnect these stations, and all new stations would feed their surplus power into a general distribution system. A company called the Union Hydro-Electrique had been formed for the purpose of building a 50,000-kilowatt station at Eguzon-sur-la-Creuse. At Chamlion a 150,000 horse-power station was to be erected, and within the next two years the Union Hydro-Electrique and the Paris-Orleans Railway would have between them electrical plant with a capacity of 244,000 horse-power.

THE HARTEBEESTPOORT DAM ON THE CROCODILE RIVER, TRANSVAAL

(*For description see page* 230.)



THE UPSTREAM FACE AND SPILLWAY FROM LEFT BANK

THE UPSTREAM FACE FROM RIGHT BANK

VIEW OF TOP OF DAM FROM RIGHT BANK

ABUTMENT ARCH FROM SPILLWAY BRIDGE

AGENTS ABROAD FOR THE SALE OF

The Engineer

BUENOS AIRES.—MITCHELL'S BOOK STORE, 576, Cangallo.
CHINA.—KELLY AND WALSH, Limited, Shanghai and Hong Kong.
EGYPT.—CAIRO EXPRESS AGENCY, near Shepheard's Hotel, Cairo.
FRANCE.—BOYVEAU AND CHEVILLET, Rue de la Banque, Paris.
CHAPELOT AND CIE., 136, Bld. St. Germain, Paris.
BELGIUM.—W. H. SMITH AND SON, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.
INDIA.—A. I. COMBRIDGE AND CO., Bombay; THACKER AND Co., Limited, Bombay; THACKER, SPINK AND Co., Calcutta.
ITALY.—MAGLIONI AND STRINI, 307, Corso, Rome; FRATELLI TREVES, Corso Umberto 1, 174, Rome; FRATELLI BOCCA, Rome; ULRICO HOEPLI, Milan.
JAPAN.—MARUZEN Co., Tokyo and Yokohama.
AFRICA.—WM. DAWSON AND SONS, Limited, 7, Sea-street (Box 49), Capetown.
C. JUTA AND Co., Johannesburg, East London and Grahamstown.
AUSTRALIA.—GORDON AND GOTCH, Limited, Melbourne, Sydney, Brisbane and Perth, &c.
MELVILLE AND MULLEN, Melbourne.
ATKINSON AND Co., Gresham-street, Adelaide.
CANADA.—DAWSON, WM., AND SONS, Limited, 87, Queen-street East, Toronto.
GORDON AND GOTCH, Limited, 132, Bay-street, Toronto.
MONTREAL NEWS Co., 386-388, St. James-street, Montreal.
TORONTO NEWS Co., 42, Yonge-street, Toronto.
CEYLON.—WIJAYAMMA AND Co., Colombo.
JAMAICA.—EDUCATIONAL SUPPLY Co., Kingston.
NEW ZEALAND.—GORDON AND GOTCH, Limited, Wellington and Christchurch; UPTON AND Co., Auckland; J. WILSON CRAIG AND Co., Napier.
STRAITS SETTLEMENTS.—KELLY AND WALSH, Limited, Singapore.
UNITED STATES OF AMERICA.—INTERNATIONAL NEWS Co., 83 and 85, Duane-street, New York; SUBSCRIPTION NEWS Co., Chicago.

Agents Abroad for Advertisements.

UNITED STATES OF AMERICA.—BRITISH AND COLONIAL PRESS, Inc., 161, East Erie-street, Chicago, Ill.
FRANCE.—AGENCE VOX, 7, Rue de Surène, Paris (VIIIe).
BELGIUM.—W. H. SMITH AND SON, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.

SUBSCRIPTIONS.

THE ENGINEER can be had, by order, from any newsagent in town or country, at the various railway stations; or it can, if preferred, be supplied direct from this office.

Half-yearly (including index number) .. £1 12s. 6d.
Yearly (including two index numbers) .. £3 5s. 0d.

If credit occur, an extra charge of two shillings and sixpence per annum will be made.

Foreign Subscriptions will be received at the rates given below. Foreign subscribers paying in advance at these rates will receive THE ENGINEER weekly and post free. Subscriptions sent by Post Office Order must be made payable to THE ENGINEER and accompanied by letter of advice to the Publisher.

THIN PAPER COPIES.	THICK PAPER COPIES.
Half-yearly .. £1 11s. 6d.	Half-yearly .. £1 13s. 0d.
Yearly .. £3 3s. 0d.	Yearly .. £3 7s. 6d.

(The difference to cover extra postage.)

Canadian Subscriptions—
Thin paper edition .. £2 16s. 6d. per annum.
Thick paper edition .. £3 3s. 0d. "

**** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

ADVERTISEMENTS.

**** The charge for Situations Open and Wanted Advertisements of four lines and under is four shillings, and one shilling per line for each additional line up to one inch. When an advertisement measures an inch or more the charge is twelve shillings per inch. The rates for all other classes of advertisements, other than those mentioned above, are included in "THE ENGINEER Directory," which is sent post free on application. All single advertisements from the country must be accompanied by a remittance in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.

Small Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication). ALTERATIONS to STANDING ADVERTISEMENTS must arrive not later than THURSDAY of the week preceding publication.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Manager, all other letters to be addressed to the Editor of THE ENGINEER.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. 2256, 2257 Central.

PUBLISHER'S NOTICES.

*** If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

TO CORRESPONDENTS.

*** All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

THE ENGINEER, February 29th, 1924.

	PAGE
A SEVEN-DAY JOURNAL	217
LOCOMOTIVE BOILER PERFORMANCE.—No. II. (Illus.)	218
THE TRAIN FERRIES	221
INSTITUTION OF MECHANICAL ENGINEERS. (Illus.)	222
OBITUARY—	
W. A. Bowden	223
MINERAL OUTPUT OF SOUTH AFRICA FOR 1923	223
AN ANGLE COMPOUND AIR COMPRESSOR. (Illus.)	225
GENERAL METHODS OF WATER PURIFICATION FOR INDUSTRIAL PURPOSES	225
SIXTY YEARS AGO	226
RAILWAY MATTERS	227
NOTES AND MEMORANDA	227
MISCELLANEA	227
LEADING ARTICLES—	
The Cruiser Programme	229
Oil Locomotives	230
THE HARTEBEESTPORT DAM. (Illus.)	230
MOTOR MACHINERY FOR FIRE-FLOATS. (Illus.)	232
PRACTICAL HYDRAULIC ENGINEERING PROBLEMS	232
THE SHIPPING INDUSTRY	232
HYDRO-ELECTRIC POWER FOR BUENOS AIRES. (Illus.)	233
TREATMENT OF WATER FOR INDUSTRIAL PURPOSES	233
THE DELFT INTERNATIONAL CONFERENCE ON APPLIED MECHANICS	234
LETTERS TO THE EDITOR—	
The Parsons' Line	235
Engineering History	235
The Severn Barrage Scheme	235
Planing Machine Drive	235
Locomotives from Germany	235
LAUNCHES AND TRIAL TRIPS	235
A TAMPING AND CONCRETE BREAKING MACHINE. (Illus.)	236
PURCHASES FOR INDIAN RAILWAYS	236
PERSONAL AND BUSINESS ANNOUNCEMENTS	237
CONTRACTS	237
PROVINCIAL LETTERS—	
The Midlands and Staffordshire	237
Lancashire	237
Sheffield	238
North of England	238
Scotland	239
Wales and Adjoining Counties	239
CURRENT PRICES FOR METALS AND FUELS	240
FRENCH ENGINEERING NOTES	241
BRITISH PATENT SPECIFICATIONS. (Illus.)	241
FORTHCOMING ENGAGEMENTS	242

THE ENGINEER.

FEBRUARY 29, 1924.

The Cruiser Programme.

IN framing the programme of naval construction which the late Government adopted a few weeks before the dissolution of Parliament, the Admiralty was legislating for what it considered to be the minimum requirements of the near future, having regard to the development of foreign building schemes and the steady wastage of our own *matériel* through obsolescence. This measure called for eight cruisers of 10,000 tons, mounting 8in. guns; two destroyers, three submarines, a minelayer, an aircraft carrier, three gunboats, and two depôt ships. It was to have initiated the process of reconstructing the Fleet on modern lines, but within the limits of the Washington Treaty. Despite the intensive shipbuilding activity of the war period, our Navy of to-day, though strong in numbers, contains a very large proportion of craft which are below the current standard of military efficiency. In light cruisers, for example, we are stronger, numerically, than all the other Powers together, yet if the test of age, dimensions, speed, radius, or armament, be applied, our cruiser fleet cuts a far less imposing figure. When these ships were designed, a speed of 29 knots was deemed satisfactory for such vessels, and they were, in fact, the swiftest of their type afloat during the war. Since then, however, improvements in marine machinery, and particularly the adoption of reduction gearing for turbines, have enabled higher velocities to be attained without any appreciable increase in weight of plant, with the result that every cruiser, without exception, built since the war has been designed for a full speed of 33 knots, or more. Many of these vessels are being added to foreign navies; Japan alone has twenty-five built or projected; the United States has ten, with eight more in contemplation; and the French programme includes nine, whilst the British navy is sadly deficient in vessels of the type and of the highest speed. The Frobisher and Effingham are designed for 31 knots, the Emerald and Enterprise for 33 knots; we have two other ships capable of 30 knots at their best, while the remainder are, for the most part, limited to 29 knots—a nominal speed which few of them could make at this date without first undergoing an extensive overhaul—and the twelve oldest ships, including those in Dominion service, cannot exceed 25 knots. Good speed is the paramount requirement in a ship built for cruising duties, but endurance is scarcely less important, and in this respect, also, the great majority of our ships are deficient. They were designed primarily for service in the North Sea, where, in view of the proximity of friendly bases, it sufficed to carry enough fuel for a short cruise. But for the ocean work involved in commerce protection they are practically useless.

To state the case in the plainest terms: Our modern Navy is strong in scouts but weak in cruisers, properly so-called. This is the inevitable result of the building policy forced upon us by the exigencies of the late war and of the strategic situation which preceded it. Invaluable so long as North Sea hostilities continued, the bulk of our light cruisers forfeited most of their value as soon as the special conditions which had brought them into being ceased to exist. Our present need is not for fleet scouts, which is the true function of the "C" and "D" units that make up about 75 per cent. of the cruiser establishment to-day, but for the large, swift, well-armed ocean-going ship which can steam her 10,000 miles on one load of fuel. Without an adequate number of vessels of this type, we should be unable to give effective protection to our sea-borne trade in a future war, and a serious interruption of that trade would, we need hardly say, be tantamount to defeat. After speed and endurance—with which seaworthiness may be bracketted—armament ranks next in importance. The "C" and "D" classes mentioned above mount a main armament of four to six 6in. guns, and no heavier metal is carried by any of our cruisers save the four "Raleighs," which are armed with the 7.5in. gun. But the Washington Treaty has led to the universal adoption of a cruiser type of 10,000 tons' displacement with a battery of 8in. guns. Just as the Dreadnought, by virtue of her immensely superior armament, rendered all previous battleships obsolete, so has the "Washington cruiser" thrust the earlier vessels of this rating into the background. If we are ever again at war with a first-class naval Power, it is with vessels of this formidable class that our commerce will be assailed, and unless we are able to meet like with like, unless we can match big cruiser against big cruiser, we shall assuredly have to deplore, not only the loss of valuable tonnage and merchandise, but a succession of naval disasters. In urging the provision of new cruisers, or, indeed, of any new men-of-war, to replace those which have become obsolete, it is quite unnecessary to draw invidious comparisons between the British Navy and the navies of other Powers. The fact that we are maintaining a post-war fleet at all is sufficient proof that sea power is still regarded as indispensable to the security of the realm. When that much is admitted, it follows as a matter of course that our Fleet must be kept up to the prevailing standard of efficiency, since otherwise it would be no safeguard but a standing menace to peace. True economy lies in the timely replacement of old, worn-out vessels by new ships designed on the most up-to-date principles. To spend money on keeping obsolete craft in service would be the most vicious form of extravagance. These, we may assume, are among the cogent reasons which have induced the new Government to decide in favour of a limited programme of new construction, notwithstanding the opposition manifested by a section of its supporters. But, in taking this courageous step, the Prime Minister and his colleagues have the great mass of the public behind them. Our only regret is that they did not move a stage further and adopt the Admiralty programme in full. However, the question of building the remaining vessels is still under consideration, and they may yet be ordered in the coming financial year. The allocation of the cruiser contracts will cause disappointment to the shipbuilding industry. Only two out of the five ships are to be laid down in private dockyards, whereas, under the original scheme of eight ships, five would have been built by contract. The placing of two 10,000-ton cruisers out to contract will not, we fear, do much to alleviate the depression from which the industry is suffering, nor is it likely to have any marked effect on the unemployment problem. Had a start been made this year with the whole of the twenty warships and auxiliaries recommended by the Admiralty, 32,000 wage-earners would have stood to benefit thereby. As things are, less than half that number will be affected. While we are not unmindful of the claims of the Royal yards, it seems to us that they have been unduly favoured on the present occasion. Irrespective of new construction, they can always rely on a steady, if reduced, volume of work in connection with the maintenance and repair of existing ships, but the private yards have no such stand-by in slack times, such as the present. We think, therefore, that three at least of the new cruisers might

have been put out to contract, and we hope that, in the event of it being decided to proceed with the balance of the programme, due weight will be given to the serious plight of those great establishments in the North which have suffered so severely through post-war naval retrenchment.

It is somewhat early to speculate on the characteristics of our new cruising ships, though their displacement and the nature of their armament have been announced in Parliament. To incorporate in a ship of 10,000 tons "standard displacement"—which is, of course, somewhat above the "normal displacement" to which British men-of-war are ordinarily designed—an armament of 8in. guns, machinery for a speed of at least 33¼ knots, protection against gunfire and submarine attack, a large fuel supply, and accommodation for some 800 officers and men, is a problem which none but the ablest constructors are competent to solve. For this very reason, however, we are confident that our new ships will be found to compare most favourably with the best coeval types in other navies. The 8in. gun is to reappear in the British Fleet after a lapse of more than thirty years. Being too heavy to be worked easily by hand, and scarcely powerful enough to justify the installation of mechanical loading gear, it was supplanted by the 9.2in. model, which continued to form the main armament of our first-class cruisers until the advent of the battle-cruiser. Only in the famous Elswick cruisers of the 'nineties, and in certain foreign ships, was the 8in. gun retained. With modern methods of power loading and manœuvring, the new gun of this calibre should be a hard-hitting, long-range piece with a high rate of fire, and a cruiser mounting a battery of such weapons would be a dangerous antagonist for anything less than a capital ship.

Oil Locomotives.

FOR ninety and odd years there has been little or no change in the principle of steam locomotive design. Some people exhibit that fact as a reflection on the intelligence of locomotive builders. It is, of course, nothing of the kind. Rather is it a testimony to the surprising fitness of the design as it left the hands of the early engineers. We all know that the steam locomotive has one great defect; its thermal efficiency, as measured at the draw-bar, is very low—at most not more than 7 per cent. But against this deficiency we may set its great simplicity. It goes about its work in the most direct way possible. It is wholly unencumbered by transmission devices. Its flexibility is enormous; it gives the highest torque at minimum velocity, and has a complete range of speeds. Moreover, it tolerates in service the most trying conditions; is relatively cheap to produce, and not, when all things are considered, very expensive to maintain. With these qualities reformers have struggled vainly. For twenty-five years and more efforts have been made to modify the steam locomotive radically; but without avail. Every change has resulted in the loss of one or more of its important characteristics. Thermal efficiency may be gained, but total economy is lost. One by one we have seen new inventions brought forward, tried, found wanting and thrown aside. The simple plan of cylinder, connecting-rod and crank has never been permanently beaten for normal service. It is not because locomotive engineers are supine and indifferent that the steam locomotive never changes; it is because every one of the changes that have been tried has failed. There are others under trial now, of which the Ljungstrom excites the most interest and holds out the most hopes. We shall see, in the course of time, if the merits it possesses outweigh its complexities.

We cannot but contemplate with regret the very low thermal efficiency of the steam locomotive. We have, indeed, advanced somewhat since the famous series of tests made by Mr. Goss on the St. Louis testing plant in 1904; but not very greatly, and it is to be feared that the draw-bar thermal efficiency never exceeds 7 per cent., and is more often than not in the neighbourhood of 4 or 5 per cent. What the engine efficiency is it is hard to say, but if the ratios which obtained in the St. Louis tests still hold good, it is never more than 8 or 9 per cent., and generally a good deal lower. There is thus ample scope for improvement, and in these days, when fuel is far more expensive than it was, thermal efficiency is of greater consequence than ever. Hence, it comes about that various new types of locomotives are attracting greater and greater attention, and amongst them the internal combustion engine, with its very high efficiency, holds a foremost place. It is, however, sometimes forgotten that efficiency is not always exactly the same thing as economy, and that such high figures as 20 to 30 and even 35 per cent. thermal efficiency do not mean that a locomotive could be run for one-fourth to one-seventh the present expenditure on coal. In the "Proceedings" of the Institution of Locomotive Engineers, Vol. XIII., Mr. F. J. Hookham gave a little table which shows at a glance how matters stand. Taking the efficiency of the steam locomotive—we presume at the draw-bar—as 5 per cent., he shows that the crude oil engine would have to develop 11 per cent., the Diesel oil engine 12½ per cent., the gas oil engine 14 per cent., and the paraffin oil engine no less than 34 per cent. efficiency, all at the draw-bar, in order to make the expenditure on fuel constant. We believe these figures to be accurate, but, obviously, they must be modified from time to time as the prices of the various fuels change. It is obvious, however, that they put the paraffin oil engine out of the question. No such engine could show anything like 34 per cent. thermal efficiency at the draw-bar, and, hence, the expenditure on fuel would increase instead of diminishing. That is, we must add, in this country. Foreign conditions might be entirely different, and it is quite possible to conceive circumstances in which even such an expensive fuel as paraffin, which Mr. Hookham puts down at 250s. per ton, would be better than coal. But as far as British service is concerned, clearly we can look only to the cheaper oils and particularly to crude oil and Diesel oil. The question we have, then, to ask ourselves is, how much of the high brake efficiency of internal combustion engines would appear usefully at the draw-bar? On that point it is extremely difficult to offer anything approaching a trustworthy opinion. All we know is that such engines must be run at a certain definite speed to retain their efficiency, and that they lack the remarkable flexibility of the steam engine which enables it to exert its maximum effort at its minimum speed. Thus, it comes about that some kind of variable speed gear must be introduced between the engine and the wheels. Some power, no doubt quite a considerable amount, must be lost in that transmission and reduction. The conditions under which locomotives work in service are extremely hard, and we must hesitate before accepting the figures for transmission losses which are presented to us as the result of calculations. There is, however, it is obvious, an ample margin between the economic draw-bar efficiency of 11 to 14 per cent. and the actual brake thermal efficiency of, say, 25 per cent. Within that margin useful progress could be made were the mechanical difficulties overcome. It is not far wrong to say that the outstanding problem of the oil locomotive is, how to start it. Once it is solved satisfactorily we shall be on the way to further developments which will have to be made by hard work and much experience. It must, however, be borne in mind that fuel economy can only result if other conditions remain constant. Will they do so in the oil locomotive? By how much will it exceed in price that of steam locomotives for equivalent service? What will be the increased cost of maintenance? Will these additional charges be counterbalanced by the important facts that fewer engines will be necessary because they will be almost instantly ready for the road and that no fuel will be burnt whilst the engines are standing by? These are all questions to which we may guess the answers, but no more. Nothing short of prolonged experience will ever show us how near our estimates are to the true facts.

We said in our opening paragraph that the steam locomotive had remained almost unchanged because it was well fitted for its work rather than because locomotive men are indifferent to improvements. We are not sure, however, that we can with equal confidence extend that defence to cover new types. As far as we are aware no railway company has ever ventured a penny piece on internal combustion locomotives, or, for that matter, on other departures from the normal type, the electric locomotive excepted. The work has been left to private firms or to little syndicates of enthusiasts. We venture to ask if the time has not come when the railway companies themselves might take up a research which is, in fact, too costly to be prosecuted for long by manufacturing firms. The savings that the companies would realise by the successful outcome of such a research are so enormous that they would surely be justified in the expenditure of two or three hundred thousand pounds upon it. They may say that they see no chance of success. We cannot agree with them. It would be possible to-day to make a thousand horse-power oil locomotive which would perform all the duties of a steam locomotive. It would be very costly, possibly uneconomical, full of serious defects, but, nevertheless, an actual locomotive, and, therefore, something to work on. We know that a machine once made can always be improved. It is the first step that counts. As long as we keep our eyes fixed only upon the difficulties and objections progress is impossible. It is necessary to do something, to risk something, before progress can be made. We can suggest to the railway companies no better way of opening the new century of railways which will begin towards the end of next year than putting an internal combustion locomotive, however imperfect, clumsy and defective it may be, on British rails.

The Hartebeestpoort Dam.

THE editor of the *South African Irrigation Department Magazine* has courteously sent to us the four views of the Hartebeestpoort Dam which were used to illustrate an article on the structure in the October number of that publication, and which are reproduced on page 228 of our issue of to-day. The following particulars of the dam, which was brought to completion last year, have been abstracted from the article in question.

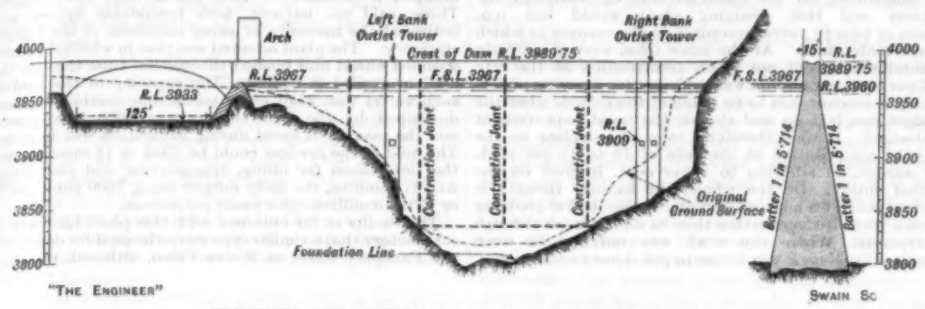
As long ago as 1902 it was proposed to increase the water supply of Pretoria by damming the Hartebeestpoort. Between 1905 and 1910 the scheme was continually under investigation by the Transvaal Irrigation Department, under Mr. Strange and Mr. Hurley as Directors, and a rough provisional plan was worked out, with recommendations that further and more detailed investigations should be made of the site of the dam and particularly of the areas to be irrigated. The advent of the Union in 1910 put a stop to further investigation of the proposal, the energies of the Irrigation Department being absorbed in other directions. The popular demand for the scheme, however, continued to grow, and extreme pressure during 1913, both in Parliament and outside, led to the hasty preparation of the project, in order to present it to Parliament for approval during the session of 1914, when a special Act was obtained in spite of opposition which demanded the appointment of a Select Committee and more detailed information.

Shortly after the scheme was approved in 1914 the war broke out, and very little was done to expedite the carrying out of the undertaking, while immediately after the war the cost of plant and material was very high. During that period, however, land was acquired, a railway, roads, and a footbridge were made, staff quarters, offices, a power-house, and a cement shed were built and a commencement made with the construction of cofferdams in the river. Towards the end of 1920 popular opinion became impatient at the slow progress made, and the necessity for providing work for unemployed whites became more pressing. Greater provision was made for pushing the work forward during the financial year 1921–2. The plans were considerably altered, and immediately after the flood season the cofferdams were completed and strengthened, so that by May 24th, 1921, the river was diverted. The excavations for the foundations were so far advanced by July 29th that the placing of concrete was commenced, and by September 7th the wall had been brought 6ft. above the river bed. Thereafter the progress was rapid and the floods of the 1922–23 season were impounded, the dam being practically completed by the end of the financial year 1922–23, or only two years after the start had been made. The road over the top of the dam was opened in September of last year, and all that then remained to be done was to complete the hydro-electric installation.

The "poort" is situated about 23 miles in a direct line west of Pretoria. The Crocodile River runs north through the "poort" in the Magaliesberg range, which runs east and west. The railway from Pretoria to Rustenburg passes through the irrigable area about 7 miles north of the "poort," and the new railway from Pretoria along the Magalies River passes about 4 miles south. The main road from Pretoria to Rustenburg passed south of the "poort," and as it was submerged by the stored water, it was deviated so as to pass over the dam.

At the site the range consists of quartzites with a northerly dip of about 30 deg. A fault lies east of the "poort," but it passes under the site of the dam at a depth of about 500ft. below river level, so that it does not affect the safety of the dam. The quartzite is compact, with widely spaced joint planes, and intrusions of igneous rock. On the east the rock is hard and suitable for crushing for concrete, but on the west the cohesion of the quartz grains is so poor that they can be separated with the fingers. Owing to a hard outside crust this was not discovered till after the work was started, and in consequence the

material excavated from the spillway, which is on the west, could not be used for concrete, a quarry being opened on the east. Abundance of good sand was found in the river bed just below the dam site. The elevation of the river bed above sea level is about 3827ft. The summer temperature is very high and the winters are cold, though frosts are not frequent.



ELEVATION AND SECTION OF THE HARTEBEESTPOORT DAM

The mean monthly rainfall and evaporation near the dam are roughly as follows (inches):—

	Rainfall.	Evaporation.
January	4.99	6.51
February	4.11	5.65
March	3.31	5.07
April	0.80	5.13
May	0.69	5.10
June	0.06	4.35
July	0.27	4.91
August	0.73	6.60
September	0.48	7.91
October	2.26	8.41
November	4.66	7.63
December	3.98	7.40
Total	26.34	74.67

The season when water is most required is in spring, from August to October. The drainage area above the dam is about 1560 square miles, coming down from the Witwatersrand and Witwatersberg. Of this area about 320 square miles are dolomite, which yields a considerable permanent supply, part of which is absorbed by existing irrigation.

From gaugings made just above the dam site it appears that the flow in the river fluctuates very considerably, not only from month to month, but from year to year. The lowest year since 1904–05 was apparently 1913–14, when the total flow was only 1614 million cubic feet for the year. The highest year was 1917–18, when the total flow was 38,406 million cubic feet. The mean of all the gaugings from the years 1904–05 to 1921–22 inclusive shows an average flow of 8308 million cubic feet per annum. The maximum recorded flood is estimated at 150,000 cusecs. The water is said to be comparatively free from silt. By Act of Parliament no other storage works can be built in the drainage area and 600 million cubic feet per annum must be passed down the river as compensation to the lower riparian owners.

The dam is of concrete. The height of the crest level of the waste weir is 140ft. above the river bed level, and the top of the solid parapet wall is 22ft. 9in. above the top of the waste weir. The level of the outlet sill is 82ft. above the river bed level, and the contents of the reservoir when full up to that point is 568 million cubic feet. With the water up to crest level the volume held up is 5936 million cubic feet, while at approximately maximum high flood level the calculated volume impounded is 9846 million cubic feet. The gross storage at the waste weir crest level is 136,241 acre-feet, and the net storage above outlet level is 123,206. The capacity can be considerably increased at a later date by placing movable gates on the spillway weir. Less than 10 per cent. of the gross storage is sacrificed in the 82ft. from outlet level to river bed level. The outlet was fixed where it is so that the discharge canals could be got through two commanding "neks." The area submerged at full supply level, *i.e.*, the waste weir crest level, is about 6.7 square miles. Rights to store up to a level of 162ft. 9in. above river bed level have, however, been acquired. At that level the submerged area would be 9.2 square miles.

The original design chosen was a gravity section which would have required a width of about 140ft. at lowest foundation level. This was altered early in 1921 to a varying radius arch dam with a bottom width of only 73ft., in order to effect economy in concrete and to enable the foundations below river level to be got in during one dry weather season.

The cofferdams were far advanced when the change of design was made; otherwise, it might have been advisable to shift the site of the dam further upstream so as to get a better abutment against the mountain on the west side. As will be seen from the section, whereas the east bank is steep to above the top of the dam, the west bank flattens out before the top is reached. As a deep trough spillway had to be excavated on the west to a floor level of about 3932.75 and the top of the dam is at 3989.75, about 57ft. of the top part of the dam was "left in the air." Consequently a very heavy abutment had to be provided on that side to take the thrust of the arch. While the upstream face was kept circular throughout an angle of 73 deg. (at the top), the downstream face was brought out on the west by means of short transition curves into a wide tangential abutment. At the bottom (3795) the radius to the upstream face was 148ft., the width of the base at the centre 73ft., and the radius to the downstream face 75ft. From the base upwards the radii were increased to fit the central section, which had both faces equally tapering upstream and downstream at 1 in 5.714 to the level 3960. Above that level the faces are vertical and 15ft. apart (top of solid parapet 3989.75). The radius of the top section is 240ft. to the upstream face. The maximum stress as calculated by the short formula is 13.3 tons per square foot, by the long formula 14.9 tons per square foot, on the assumption of pure arch action unrestrained by other forces. Calculations based on Craeger's method of treatment, in which the arch is assumed restrained at the base and the vertical beam capable of rotation about the base, give a maximum stress of 19.4 tons per square foot. The level of the plane at which maximum stress occurs is higher in the case of the short formula than for the long formula and higher still in the case of the restrained arch.

Four radial contraction joints were provided above the level 3835 at intervals of from 64ft. to 78ft. The massive ornamental arch and the spillway bridge contribute a little towards the strength of the west abutment. The height from lowest foundation level (3795) to top of solid parapet (3989.75) is 194.75ft.

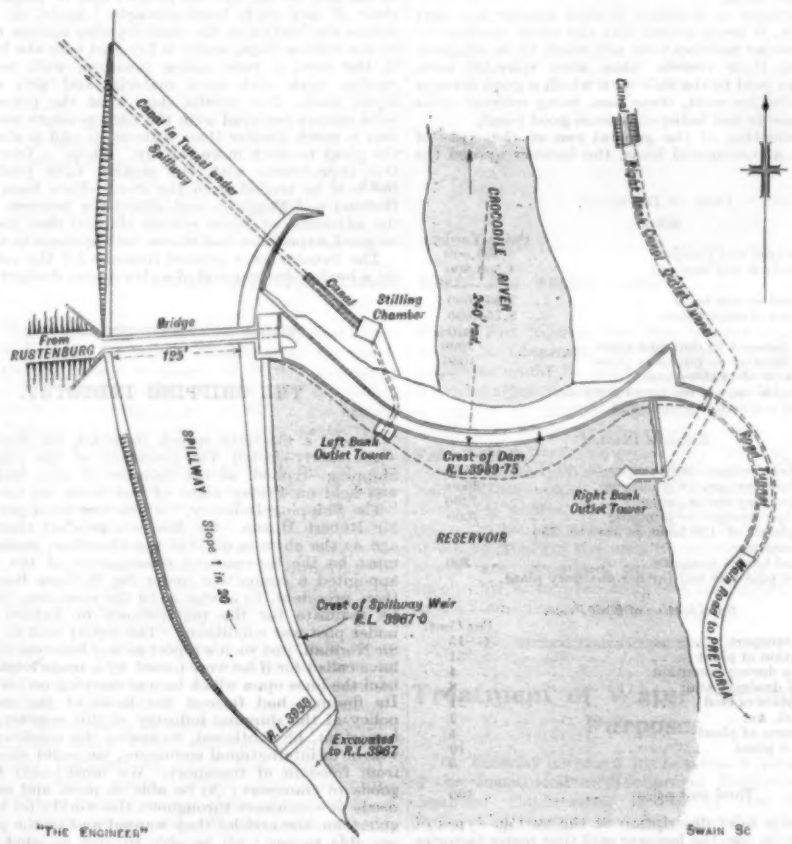
The water rose continuously in the dam, and at the end of September, 1923, it stood at the level of 3953.3, spillway level being 3967. Special arrangements were made for measuring any deflection in the dam.

Two outlets have been provided, one for each bank, with sill level at 3909. On the east a tunnel is cut through the mountain side and the water enters it through a tower with four gate valves of 30in. diameter arranged in pairs opposite each other. The capacity of the canal on the east is 300 cusecs and a mean flow of 19 cusecs has to be passed to the river for compensation.

The drop to the river will be utilised to drive a small hydro-electric plant for electric light and pumping near the dam. The outlet on the west passes through the dam wall by means of a 5ft. diameter cast iron pipe embedded in the concrete. At the upstream end an emergency roller gate, 5ft. diameter, works in a tower built against the dam, and at the downstream end the pipe divides into three smaller pipes, the two outer ones being controlled by 24in. gate valves and the central one by a 30in. diameter gate valve, which discharges against reinforced concrete walls. The west furrow has a capacity of 150 cusecs and passes under the spillway.

The spillway is cut as a trough on the west, and the weir is built on the edge of the excavation. Its crest is at 3967 and its total length is 421ft. 6in. The face of the cliff below the spillway down to level about 3920 was coated with gunite. At the upper end the level of the spillway floor is 3953 and its width 56ft. From there it falls at a slope of 1 in 20 and widens to a width of 125ft. at the bridge. The floor is lined with concrete approximately 3ft. thick near the weir wall and 18in. at the far side. The side against the weir is at a slope of $\frac{1}{2}$ to 1 and is lined with concrete. The far side is lined with a low wall which rises near the bridge. Weeper holes pierce the concrete and it is reinforced under the bridge. The bridge over the spillway is reinforced and has a clear span of 141ft. 6in.

The road deviation was quite a work in itself. Altogether some 6 miles of new main road had to be made, but the most difficult part was for 140 yards along the almost vertical eastern mountain side, the last 175ft. being in tunnel. The length of the road over the dam top is 163 yards and over the spillway bridge 49 yards. Crossing places for traffic are provided at both ends of the tunnel, the dam and the bridge. Some of the extra weight required in the west abutment has been placed in an ornamental concrete archway. It is 41ft. high and roughly follows the proportions of the Arc de Triomphe in Paris.



PLAN OF DAM AND SPILLWAY

A NEW and important transport system, upon which work has already been commenced, is about to be provided for Western Mexico. The Southern Pacific Railway of Mexico Company is constructing a line from Tepic—one of the oldest towns on the west coast—to La Quemada, in the State of Jalisco. The new route, which will cover a length of 103 miles and will cost 15,000,000 dollars, and which will materially shorten the time of travel between the two towns, is expected to be completed by the end of March, 1926. From Tepic to Ixtlán-del-Rio work will be comparatively light, consisting mainly of cutting and filling, with but one tunnel. In the last 25 miles, however, there will be 35 tunnels, the longest measuring 900 metres. A large number of bridges will be built over the Miravalles River, and another will cross a canyon of considerable width and depth. Part of the material is being transported by water to the port of Manzanillo, thence to the city of Guadalajara by rail; but the greater proportion, including heavy machinery, is being carried through the border town of Nogales, in the State of Arizona, to Tepic, and thence to railhead.

Motor Machinery for Fire-floats.

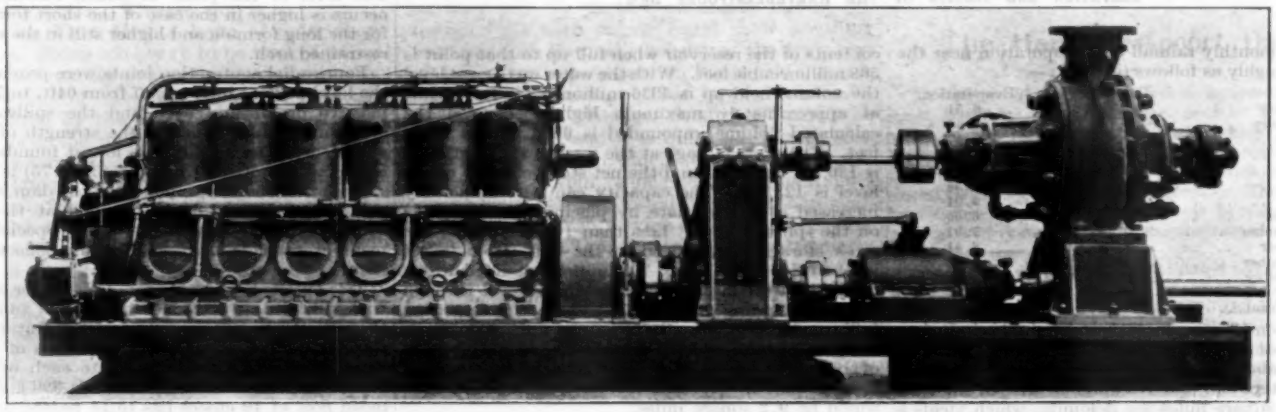
THE illustration which accompanies this article shows what we believe to be a new application of the internal combustion motor. In the plant, which is for installation in a fire-float, the same motor serves to propel the vessel and also to drive the pumping machinery. It was built by the Parsons Motor Company, Limited, Southampton, and is intended for a fire-float of about 50ft. long with a 10ft. beam. The engine itself is a standard Parsons six-cylinder paraffin motor, designed to develop 90 brake horse-power when running at a normal speed of 750 revolutions per minute. A similar type of engine has already been described in our columns, and we need only mention its outstanding features, such as enclosed high-speed governor, forced lubrication, impulse starter, and pump-driven water-cooling arrangements. In this particular case an electric starting gear is fitted, but the engine can also be started by hand in the usual manner.

Referring to the drive, the following points may be noted. The fly-wheel carries the standard Parsons type metal-to-metal clutch, enabling the engine to be run free when the clutch is out. Adjacent to the clutch is a vertical gear-box enclosing a silent chain drive, a dog clutch, which is operated by a lever, being also fitted to the main shaft. The upper spindle in the gear-box is driven by the chain at a speed of 1700 revolutions per minute and drives the pump direct. The lower shaft passes on and is coupled to a Parsons reversing gear of the ordinary type, which gives a direct drive at the same speed ahead and astern with a neutral position. Aft of the reversing gear is placed the propeller shaft itself with the stern tube and propeller.

When the fire-float is proceeding to its destination or answering a fire call, the dog clutch we have already referred to is thrown out, and the engine drives the propeller direct, ahead and astern motions being obtained by movement of the hand lever of the reversing gear. When the destination is reached, the reversing gear being in neutral, the fly-wheel clutch is thrown out and the dog clutch for the pump drive put into gear. When the fly-wheel is again engaged the engine drives the pump, but the propeller shaft is not turned because the reversing gear on the lower shaft is in neutral position.

One advantage of the arrangement shown is that the lay-out is of minimum length owing to the pump being placed directly above the reversing gear. The installation has been specially designed for fire-fighting purposes, but it is equally applicable to other uses, such as a salvage boat or craft for water and oil supply. Indeed, it may be used on any type of craft which has to propel itself and transfer liquids of any kind.

In the example we show a 7in. delivery two-stage turbine pressure pump as employed, its capacity being designed for a delivery of about 600 gallons per minute against a total head of 310ft. In operation the plant, so the makers inform us, is very quiet, largely, no doubt, owing to the adoption of the silent chain drive completely enclosed in the gear casing.



COMBINED PROPELLING AND PUMPING MACHINERY FOR A FIRE-FLOAT

Practical Hydraulic Engineering Problems.

AT the Institution of Civil Engineers on Monday, February 25th, the first of six lectures on the above-named subject was delivered as part of the series of advanced lectures in engineering, arranged by the University of London. The lecturer for the present course is Mr. O. C. A. van Lidth de Jeude, formerly civil engineer to the Netherlands Government Public Works Department, and now technical managing director to the Netherlands Harbour Works Company. Mr. Basil Mott presided.

The first lecture dealt with dredging and dredging plant, and gave a survey of what might be termed the general principles applying to dredging and dredging plants in order to make the work of a commercial success. Emphasis was laid upon the need for a careful study of the local conditions where dredging is to be done, in order that the right type of plant may be selected, although it was pointed out that there are cases in which the most suitable plant is prevented from being used owing to circumstances, such as other plant being on the spot and the expense of transporting more suitable gear, or the absence of money to procure any other type than that which happens to be at hand. Instances were mentioned in which bucket dredgers had been used, whereas much more satisfactory results would have been obtained with grab dredgers, and *vice versâ*. Special stress was laid upon the importance of a thorough preliminary examination of the bottom to be dredged before deciding upon the type of plant, and on this point mention was made of a Far Eastern scheme in which all the estimates and plans were based upon the assumption that the bottom was sand, when, as a matter of fact, it turned out to be mud. Again, attention was called to the importance of a careful examination of the best means for transporting the dredged material.

Commenting on the financial side of dredging, the lecturer said that dredging plant would last ten, fifteen or twenty years, according to the manner in which it was maintained. At the same time, even if properly maintained, he did not think amortisation at the rate of 5 per cent. per annum was sufficient for a paying undertaking if account was to be taken of the periods when the dredger was laid up and also of the rapid improvement in designs. It was, therefore, safer to calculate on the basis of amortisation at the rate of 10 to 15 per cent. per annum, in addition to 6 per cent. interest on the capital outlay. On the whole, the lecturer thought it the best policy for authorities doing a great deal of dredging to own their dredgers rather than to do the work through contractors. Where the work was only to be done occasionally, then it was better to put it out to contract.

Discussing the measurement of dredged material, the difficulties to be encountered were mentioned, and the view was expressed that the safest course is to adopt the system of measuring the dredged material as deposited in the barges or pontoons, although there were objections even to that course on account of the large quantity of material which flows overboard with the water. On the whole, however, that method was likely to give the more accurate result.

The importance of a skilled dredger master was next insisted upon, it being added that the social qualities of the usual dredger masters were not much to be admired, although, on their vessels, they were splendid men. A tribute was paid to the skill with which a good dredger master handles his craft, these men being referred to as being as valuable and indispensable as good plant.

As an indication of the general run of the costs of dredging on a commercial basis, the lecturer quoted the following :—

COST OF DREDGING.

Scheme.

	Cubic Yards.
To be dredged and pumped	5,500,000
To be dredged and dumped	1,500,000
Measured *in situ* total	7,000,000
In means of conveyance	8,750,000
	Yards.
Average distance to dumping place	2000
Average distance to pumping place	1000

To be executed in three years.
250 workable days of ten hours per year.
Nature of soil soft clay and mud.

Required Plant.

	Cubic Yards.
One bucket dredger, daily output	3000
One bucket dredger, daily output	3600
One hopper clay-cutter, output	7200
One suction dredger for pumping	7000
Five tugboats of 150 horse-power to 250 horse-power.	
Eight mud barges contents	300

Necessary pipe-line and further auxiliary plant.

Specification of Unit Price.

	Per Cent.
Cost of transport	15
Depreciation of plant	31
Insurance during execution	4
Wages of dredging staff	8
Consumption of coal	21
Grease, oil, &c.	2
Maintenance of plant	4
Repairs of plant	10
Sundries	5
Total unit price	100

Passing to a brief description of the various types of dredgers now in use, the lecturer said that many factories had tried to turn out dredging plant, but it was only those who had had many years' experience and were in constant touch with dredging operations who could hope to design the right type of plant. Perhaps it was because in the Netherlands, a low-lying country, they were constantly having to carry out dredging operations, they had seen the development there of a really important industry in the manufacture of dredging plant. Dredgers were divided into the three types, viz., grab dredgers, bucket dredgers and suction dredgers, there being, of course, several variations of each class. The well-known features of the various types were briefly referred to, and at the end of the lecture, lantern slides of typical plants were shown.

The most powerful dredgers ever built, the lecturer said, are some suction hopper dredgers having a displacement of 6000 tons for use in deepening the entrance to the river La Plata at the Port of Buenos Aires. The scheme involved the excavation of 150 million cubic yards for a length of several miles, the dredged material to be dumped a distance of 1700 yards from the channel. These, said the lecturer, were formidable figures, and indicated the necessity of using machines of the highest efficiency. The plant adopted was that in which the vessel steamed ahead and pushed the suction tube through the mud or trailed it behind. The capacity of the hold of each vessel was 2350 cubic yards, the maximum power developed by the four engines was 2600 horse-power, and the maximum speed during navigation was 11 knots. The hold of the dredger could be filled in 11 minutes, and the time taken for filling, transporting and discharging was 37 minutes, the daily output being 7000 cubic yards, or 13 to 16 million cubic yards per annum.

The results so far obtained with this plant had been so satisfactory that a similar type was to be used for deepening the Paraguay River at Monte Video, although the work would be on a somewhat smaller scale. There was, however, the prospect of it being enlarged and providing work for several years.

Describing a few of the outstanding features of the plant used on the La Plata River, it was pointed out that in order to reduce the possibility of damage when the suction tube is pushed through the soil at the bottom and meets an obstruction, the tube has been made telescopic and by an upward motion can be made to come clear of any such hard obstacle. Again, in order to reduce the friction of the semi-dry clay against the inside of the suction tube, water is injected into the lower part of the suction tube under pressure, with remarkable results, both with hard material and also with soft liquid mud. The results show that the percentage of solid matter removed with the high-pressure water injection is much greater than without it, and it also enables the plant to work more rapidly. Three or four boats of this type—some with the suction tube pushed from the bow or trailed from the stern—have been made in Holland and England, and, added the lecturer, although the advocates of either system claimed that the other is no good, experience had shown both systems to work well.

The lecturer gave printed formulæ for the calculations for a bucket dredger and of a clay-cutter dredger.

THE SHIPPING INDUSTRY.

IT was a masterly speech in which Sir Norman Hill—the newly-elected Vice-president of the Chamber of Shipping—replied, at the banquet of that body, which was held on Friday night of last week, to the toast of "The Shipping Industry," which had been proposed by Sir Robert Horne. Sir Norman recalled that as long ago as the autumn of 1916 the Chamber, realising what must be the far-reaching consequence of the war, had appointed a committee under Sir William Raeburn, its then president, to advise as to the measures that would be requisite for the maintenance of British shipping under post-war conditions. The report sent in was, said Sir Norman, just such a report as any business man would have called for if he were forced by a trade crisis to overhaul the lines upon which he was carrying on his business. Its findings had formed the basis of the subsequent policy of the shipping industry of this country. It was important, he continued, to realise the conditions under which, in international commerce, we could alone benefit from freedom of transport. We must :—(*a*) Have the goods to transport ; (*b*) be able to meet and satisfy the needs of consumers throughout the world ; (*c*) be able to give them the articles they wanted and at the price they are able to pay ; (*d*) be able to give as good value in quality as well as in price as any other manufacturers and traders in every part of the world ; and (*e*) we must charge less or give more. A banquet was not, he added, an occasion on which to enter on the question of the adjustment as between capital invested in the shipping industry and the labour employed in that industry, or of the burden that must be borne to enable our overseas trade to be retained and developed. The great point was to realise that the burden had got to be borne, and for each and all to help one another in bearing it.

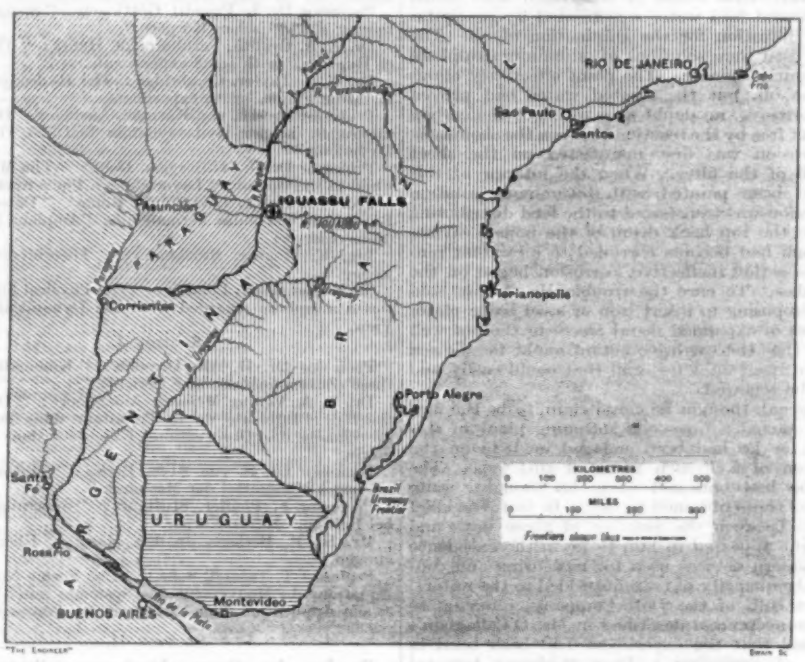
Hydro-electric Power for Buenos Aires.

ON the far frontier of Brazil and Argentina, the river Iguassú, flowing from east to west, joins the Paraná, which flows from north to south. The Iguassú divides Brazil on the north bank from the northern corner of Argentina on the south bank, and beyond the Paraná, to the west, lies the State of Paraguay.

Just before it enters the navigable waters of the great river of the central plains, the Iguassú falls sharply, forming the Salto de Iguassú, or Iguassú Waterfall, which is an important potential source of power. The distance from the falls to Rio de Janeiro is, in a direct line, about 1150 kiloms.; to Buenos Aires about 1050 kiloms. Owing, however, to topographical difficulties, the length of a practical route for a transmission line to Rio would probably be very considerably greater than the length of a much easier route to Buenos Aires, which is estimated at 1200 kiloms.

Should a hydro-electric power station be established at the falls, the destination of the greater part of the power is likely, however, to be decided by the fact that Brazil has water-power resources compared with which those of Argentina are unimportant.

The city of Rio de Janeiro is supplied, liberally, with light and power from a station only 50 miles distant, where there is a head of about 1000ft. The important industrial city of Sao Paulo has a power station distant less than 20 miles, and obtains a further supply from the Sorocaba Falls, about 50 miles away, these falls also supplying several other towns. The station which supplies the city and docks of Santos is only 20 miles distant from the port. On the river Piabana a plant, of 15,000 kilowatts capacity, has been installed, and the available energy there is estimated at 80,000 horse-power. On the Paraguassú a project for using three falls, with some 100,000 horse-power, is in hand.



SOURCE OF HYDRO-ELECTRIC POWER FOR BUENOS AIRES

Potential supplies in Brazil include those of Sete Quedas ("the seven falls"), estimated at some millions of horse-power; Paolo Affonso, more than a million; two or three others of more than half a million each, and several at which the available power is, in each case, estimated in hundreds of thousands. The total number of falls which could be used with no great difficulty, and in some cases easily, is reported as being about 1500.

The studies that have already been made show that variations in the flow of the Iguassú, and in the water levels below the falls, are considerable and important. One set of current meter measurements gave the results, in cubic metres per second: Minimum, 350; mean, 1500; and maximum, 10,000; or, in round numbers in cubic feet per second: Minimum, 12,000; mean, 53,000, and maximum, 353,000. Other measurements gave a minimum of 420 cubic metres per second. Water level records, below the falls, are: Extreme low water, 15 m.; ordinary low water, 22 m.; ordinary water level, regarded as the average, 28 m.; ordinary high-water level, 36 m.; highest flood level, 53 m. The intake level being put at 100 m., the minimum head is 47 m. (100 — 53). The smaller flows will be accompanied by low water levels below the falls, and the estimated head for the minimum—or nearly minimum—discharge of 400 cubic metres per second, is taken as 70 m. This is the basis of the calculations of power.

$$400 \times 70 \times \frac{1000}{75} = 373{,}333 \text{ water horse-power (metric).}$$

Assuming a conversion efficiency of 75 per cent., we have—

$$\text{Horse-power} = \frac{1000}{75} \times Q \times H \times 0.75 = 10 \times Q \times H$$

or,

$$\text{kilowatts} = 7.46 \times Q \times H.$$

As it is proposed, provisionally, that half the available power should be allotted to Buenos Aires, we have—

$$\text{Kilowatts} = 7.46 \times 200 \times 70 = 104{,}000, \text{ nearly.}$$

The following efficiencies are assumed: Alternators, 0.96; transformers, up, 0.98; transmission (1200 kiloms., or 744 miles), 0.80; transformers, down, 0.98; or a whole efficiency of, say, 74 per cent., giving about 77,000 kilowatts in Buenos Aires.

For nine months in the year a considerably greater minimum flow could be relied upon, and it is estimated that for these nine months 125,000 kilowatts could be available in Buenos Aires. The consumption of electricity in the city is about 400 million kilowatt-hours per annum, or an average of 45,000 kilowatts, the present plant having an output of 160,000 kilowatts. The conclusion is that for nine months in the year the supply from the Iguassú would be almost always sufficient, while for the remaining three months it could be supplemented from the local plants, while if the whole, instead of one-half, of the power at the falls were allotted to the Argentine capital, this supply would render the city independent of the local plants, except as a reserve in case of an interruption to the supply from the Iguassú.

Another possible source of supply for Buenos Aires is a fall on the river Uruguay. By building a dam about 17 m. high at this spot, a head of about 23 m. would be obtained, and a supply of about 70,000 kilowatts could be made available in Buenos Aires. From another fall on the same river, it is estimated a supply of 25,000 kilowatts could be obtained. There are, however, other towns which could make good use of these supplies, and the project for devoting one-half, or more, of the output of the Iguassú Fall to Buenos Aires is a very attractive one. Apart from this aspect of the situation, the presence of this important source of power on the Western frontier of Brazil, beyond the area in which sources of water power are abundant and conditions for storage favourable, is an interesting fact and one of importance to the countries concerned.

Treatment of Water for Industrial Purposes.

ON Tuesday evening in London a joint meeting of the Institution of Mechanical Engineers and the Chemical Engineering Group of the Society of Chemical Industry, was held for the presentation and discussion of a symposium of four papers on the treatment of water for industrial purposes.

The first paper presented was entitled "The Treatment of Condensing Water," and was contributed by Mr. H. W. Coulson. The following extract covers the main portions of this paper.

THE TREATMENT OF CONDENSING WATER.

THE principles of filtration and softening of water supplies are well known, and can be economically applied to industries where the cost entailed by the particular process bears a reasonable relation to the advantages which accrue from such treatment; but in some cases the volume of water to be handled is so great and its use so incidental that considerations of purification along the usual lines are entirely outside the pale of economical possibility. A case in point is the treatment of the water used for circulating purposes in surface condensers, where a power station of moderate dimensions may circulate as much as one million gallons of water per hour.

Where the necessity of conserving the water supply entails the installation of cooling towers, water treatment plant can be, and is, economically applied to deal with the make-up, which may only amount to 5 per cent. or 10 per cent. of the total; but this is only resorted to in cases where the water contains a large amount of encrusting salts, which would give trouble by the deposit of scale in the condensers.

The necessity for large quantities of water for cooling purposes frequently fixes the site of the power plant on the side of a river or canal. Nearly all such waters contain vegetable matter and micro-organisms, notably algæ, and the passage of the water through the plant raises it to a temperature which assists the rapid development of the organisms. This results in the formation of a gelatinous deposit upon the inner surfaces of the condenser tubes, and the deposit acts as an insulator to the passage of heat from the condensing steam.

As far as the author is aware no attempt has ever been made, until quite recently, to treat economically large volumes of water which have immediately to be rejected after once passing through the circulating system, and on the face of it, it would appear as if no such process of treatment could ever be regarded as an economical proceeding. It has, however, recently been found that an exceedingly minute dose of chlorine added to the circulating water completely inhibits the formation of the jelly-like deposit which would otherwise act as an effective barrier to heat transference, leading to progressive loss of vacuum, and entailing frequent cleaning.

The maintenance of a high vacuum is a matter of supreme importance. It has been estimated that a variation of 1in. affects the steam consumption—and, therefore, the fuel consumption—to the extent of about 6 per cent. It will be obvious that there is a very wide application for a method which maintains the condenser tubes always in a clean condition, and therefore always at a maximum efficiency, as compared with any arrangement whereby a progressive loss of vacuum eventually leads to a point where cleaning is imperative.

The quantity of chlorine required is extremely small—in most cases one-third of a part per million is sufficient to maintain the condenser tubes in a clean condition.

An objection is sometimes raised that corrosion of metal fittings might occur in the presence of chlorine. The experience gained at a number of power plants, some using as much as two million gallons of water per hour, where this treatment has been in use for the past two years shows that no corrosion whatever takes place. It would appear that the chlorine is immediately absorbed by the organic matter present in the water, as no free chlorine can be detected in samples collected from the condenser discharge.

The chloronome is an instrument which has been developed for the chlorination of circulating and others waters. Chlorine is purchased in liquid form in steel cylinders, each of which contains about seventy pounds. The cylinders are connected to the chloronome by suitable tubing.

When the cylinder valve is opened, the chlorine issues as gas and passes to the control board, which reduces it to a uniform low pressure, and measures the flow on a manometer, the rate being indicated by the level of the liquid in a glass U-tube against a suitable scale. Stop and regulating valves are provided for controlling the flow of gas. On leaving the control board, the gas flows through an acid seal to the chlorine absorption tower, behind the board, where it is converted into an aqueous solution which is fed into the water requiring treatment. This method of dissolving the chlorine in a minor body of water facilitates the dissemination of the gas throughout the main body of water, and has a very important bearing upon the prevention of corrosion.

The second paper entitled "General Methods of Water Purification for Industrial Purposes," was presented by Mr. B. Heastie. A lengthy abstract of it will be found elsewhere in this issue.

WATER PURIFICATION FOR INDUSTRIAL PURPOSES.

The third paper, by Mr. J. P. O'Callaghan, entitled "Water Purification for Industrial Purposes," was in three parts. In the first the author illustrated modern methods of removing suspended matter from turbid river water by describing the sedimentation and filtration plant at the Gas Light and Coke Company's Beckton Works. A fully illustrated description of that plant was given in our issue of August 17th, 1923. In the second part of his paper Mr. O'Callaghan dealt with the Lassen-Hjort lime-soda process for softening water, and gave results achieved with that system at the Swindon works of the Great Western Railway, where the process has been in use for ten years. From the third portion dealing with the "Permutit" zeolite softening process we take the following:—

Softening by the Permutit Zeolite Process.—The name "Zeolite" is applied to the hydrated silicates of alumina combined with sodium, potassium, calcium, magnesium, and other metals. These substances possess the remarkable property of exchanging their metallic bases for others under appropriate conditions of contact, and of effecting the exchange in the reverse direction. For instance, a zeolite containing sodium as its base is able to replace the sodium with calcium if exposed to contact with a solution of a calcium salt. When the calcium zeolite has been formed, it can be readily reconverted into the sodium salt by similar treatment with a solution of sodium chloride. By the power of base-exchange which Permutit possesses—both calcium and magnesium are completely removed from water which is passed through a "Permutit," or zeolite, softener—all traces of hardness disappear, and the water, when tested, gives a ready lather with a minimum quantity of soap. The softeners are without moving parts, the entire process consisting of the simple filtration of the hard water through a bed of the Permutit material. The installation of plant of the largest size, therefore, presents little difficulty, while, in the case of the natural Permutit lately adopted, depreciation is a practically negligible item, and the labour required to operate is exceedingly small. As the softening power of a Permutit plant is drawn upon by the water itself in exact accordance with its hardness and its rate of flow, it follows that Permutit softening precludes the possibility of under-treatment or over-treatment. Variation in the quality and quantity of the water within the limits of the capacity of the plant makes no difference, whereas, in such cases of variation, a lime-soda water softener would require frequent readjustment.

Another type of Permutit has recently been introduced for industrial use. This new materials named "Permutit B," differs from ordinary Permutit both in physical characteristics and molecular constitution, these differences causing a radical change in the timing of the periodic cycle of softening and regeneration, enabling day and night continuous duty to be performed by one unit only instead of two. In the case of

ordinary Permutit a single unit was usually designed to soften continuously for a maximum period of 10 or 12 hours, and it then required an equal length of time for regeneration. Therefore, day and night working involved employment of two units. In the case of Permutit B, the plant is designed to operate for periods varying from 3 to 6 hours at a time, and is then completely exhausted. The material, however, is capable of extremely rapid regeneration, and a large industrial unit can be completely regenerated and recommissioned in an hour.

Although the actual base-exchange activity of the new material is somewhat less than that of the ordinary Permutit, this is amply compensated for by the more rapid action of the material in both directions, *i.e.*, during softening and regeneration. By taking advantage of this, a higher rate of flow during softening can be obtained, while the reduction of the period of regeneration from 12 hours to 1 hour has become ordinary practice. The introduction of the new material has very sensibly advanced the base-exchange process in the direction of continuous operation, and made possible a considerable saving in first cost, one unit only being required. A most important advantage is that a reduced salt consumption in regeneration is possible with Permutit B as compared with the older material. Again, the new material is of a hardier physical character and, therefore, less susceptible to loss through wear and tear in general usage.

At several places combined lime-soda and Permutit systems have been installed and are operating satisfactorily. It is not usually economical to treat a water entirely by the regenerative process where the hardness of the water is in excess of 40 grains per gallon, and in such cases a combined plant can be effectively employed.

In several manufacturing processes it is desirable that the water used should be absolutely free from both iron and manganese, and, when these are present only in very minute quantities, it is almost impossible to remove them entirely by any of the older processes. A modification of the Permutit process makes this removal possible. By treating sodium Permutit with a manganese salt, a manganese Permutit is produced, and, upon passing water through a layer of this arranged in an apparatus similar to that used to remove hardness, all the iron and manganese salts are oxidised and precipitated. This is not a lime exchange action, but an oxidising process. At the same time, all organic matter and any bacteria which may be present are also oxidised, the manganese Permutit being periodically regenerated by the adcition of solution of permanganate of potash. The process is very simple and thoroughly effective, costing for regeneration less than ¼d. per 1000 gallons

---

The fourth paper, by Messrs. T. P. Hilditch and H. J. Wheaton, was entitled "Water Softening by Means of Doucil." Its contents are summarised in what follows :—

WATER SOFTENING BY MEANS OF DOUCIL.

The softening of water by passage through a bed of base-exchanging material has become so familiar a process that it is only necessary to point out that lime and magnesia in hard water are exchanged for the equivalent of soda, and that the spent material is regenerated by passage of brine through it.

Hence, the operating costs are the salt required, together with water—for solution of the salt and for washing the spent brine out of the filter and occasionally for flushing the filter—and the small amount of labour necessary to carry out this operation.

The present note is concerned with a description of a comparatively new base-exchange material manufactured by J. Crosfield and Sons, Limited, of Warrington, under the name of Doucil. The oldest base-exchanging compounds on the market, the natural zeolites, consist of rounded granules of no great degree of porosity, and it is evident that all the softening action takes place very close to the external bounding surface of the grain. Indeed, chemical analysis shows that but a small proportion of the soda content of a natural zeolite is available in water softening.

The first type of doucil gel made was simply a very acid sodium silicate, made by the interaction of dilute solutions of sodium silicate and a mineral acid, or preferably of an acid salt, of which sodium bicarbonate is one of the most convenient to use. These products, however, do not contain more than about 3 per cent. of combined sodium oxide, and not much more than one-third of this is available for base-exchange, the remainder being, apparently, converted into a calcium silicate.

A similar process takes place when a dilute solution of ordinary sodium silicate, containing two to four molecules of silica to one of soda, is mixed with dilute sodium aluminate solution; silica is a stronger acid than aluminium oxide, and sodium oxide is withdrawn from the aluminate with production of sodium metasilicate. The residual components enter into combination as a sodium alumino-silicate, which is produced in the form of a gel.

Doucil is marketed on a 50 per cent. moisture basis, which is equivalent to saying that a ton of doucil will soften to "zero hardness" about 22,000 gallons of water, containing 20 parts of lime per 100,000 (or 25 grains of calcium carbonate per gallon).

The early stages of manufacture are all-important in securing both high activity and hardness of grain; the generating solutions must be so mixed that the whole sets to a perfectly homogeneous mass of gel. This is controlled by careful adjustment of the concentrations of the aluminate and silicate solutions, and of their respective soda contents, and by suitable mixing devices.

The fresh gel is transferred without disturbance to a drier, in which it remains for four or five days whilst its water content, originally about 90 per cent., is reduced to about 50 per cent. The dried gel is quite hard, and of a somewhat horny appearance, and is generally obtained by shrinkage during drying in the form of lumps about 2in. in diameter. These are washed in a slow stream of distilled water for some hours, during which the enmeshed sodium metasilicate, &c., is dissolved away, leaving the doucil in whitish lumps which are submitted to further drying for about a day. This second drying assists to harden the material, and also renders it more easy to break down into grains of the desired size. The production of the latter is now a purely mechanical problem.

The preferred size is now from ¼in. to $^1/_{20}$in., whilst a still smaller size, $^1/_{30}$in. to $^1/_{50}$in., is sufficiently granular to be very useful as a top layer in a doucil filter. A bed 6ft. deep of the former size offers a resistance to water flow of only about 1 lb. per square inch at normal rates of flow, whilst a 3ft. bed of the smaller grade has a resistance of about 4 lb. per square inch under similar conditions.

The salt consumption is much reduced by using the last portion of the brine from one regeneration as the first half of the brine for the next regeneration; in this way the consumption is about 8 lb. of salt per 1000 gallons of completely softened water of an original hardness of 20 parts of calcium oxide per 100,000. The amount of water used in the solution of salt—5 per cent. brine—washing and occasional back-flushing does not exceed 4 or 5 per cent. of the water softened. The partially spent and fresh brine should each occupy about 20 min. to 30 min. in passage through the doucil bed, after which washing is carried out as rapidly as possible and need not exceed 15 min. to 20 min. The plant may be designed so as to be regenerated daily, weekly, or at any suitable intervals.

Dr. Hele Shaw, who was invited by the chairman, Mr. W. H. Patchell, to open the discussion, dealt exclusively with his now well-known streamline filter, of which he had a large working example on exhibition. Dealing with the improvements which he, in conjunction with Mr. Garland, the vice-president of the Society of Chemical Industry, had recently effected in the design of the stream-line filter, he drew attention to a pile of sheets of perforated waterproof paper. Each sheet, he said, represented something like 50 separate filters, and there were 7000 sheets in the pile. In the large plant exhibited there were three such piles, so that altogether there were something over a million separate filters in it. The plant was capable of dealing with 500 gallons of water per hour, and was to be used for removing grease from boiler-feed water. He called attention to the fact that the filter was now being made without an external casing, that an improved method of cleaning the filter by the reversal of the pressure flow was adopted, and that it was possible to determine within a pound or so what precise total force, of the order of half a ton, was being applied to the pile.

Mr. T. H. Adams, chemist to the Midland Division of the London, Midland and Scottish Railway, said that his company had for many years used on a large scale water derived from a tunnel. For boilers, particularly locomotive boilers, this water had a marked corrosive action. Analysis of the water revealed a very constant composition, but failed to show any reason for the corrosive action. The dissolved oxygen and carbon dioxide were not at all excessive, being about 0.66 and 0.52 grains per gallon. Efforts made to eradicate the corrosive tendency had not met with complete success. Even the use of an excess of lime above the amount required for ordinary softening resulted in the corrosion being localised but not eliminated. Another interesting case of corrosion had arisen in connection with a water-tube boiler in connection with which the condensed feed water was treated by precipitation and filtration for the elimination of oil. The reagents used were solutions of aluminium sulphate and sodium carbonate. The plant effectively eliminated the oil, but the treated water had proved highly corrosive, no doubt as a result of the carbon dioxide set free by the reaction between the chemicals. The corrosion was first manifested on the sheet iron shell of the filter. When the interior of this shell had been painted with bituminous solution the corrosion was transferred to the feed distributing trough in the top back drum of the boiler. When this trough had become corroded to an extent rendering its action ineffective, corrosion began on the boiler tubes. To cure the trouble Mr. Adams said he was proposing to insert iron or steel baffle plates or a series of expanded metal pieces in the hot well in order that the corrosive action might be allowed to expend itself on a material that could easily and cheaply be renewed.

Mr. Macnab thought he could claim to be the first to have started a lime-soda softening plant in this country, for he had been engaged in 1885 on the installation of a French plant of this type. The results he had obtained were, he thought, quite as good as those obtained to-day. In fact, the chief difference between the practice of those days and the present appeared to him to lie in the excellence of the modern devices used for measuring and controlling the quantity of reagents added to the water.

Colonel Hill, of the Dorr Company, referring to the softening process described in Mr. O'Callaghan's paper, said that the experiment had been tried in America of arranging a Dorr thickener between the clarifier and coagulator and detaining the water for an hour. In this way 95 per cent. of the solids were taken out in the thickener, the output of the apparatus was greatly increased and the condition of the filter improved.

Miss Snowden asked some questions of a purely chemical nature regarding the methods of determining hardness in water, the best temperature at which to add the reagents, and the estimation of the free and combined carbonic acid in industrial waters.

Mr. Stewart advocated the use of barium carbonate for the removal of calcium and magnesium sulphates by precipitation in the form of barium sulphate and calcium carbonate or magnesium carbonate. He also suggested the use of barium hydrate instead of lime, for removing temporary hardness, when a double carbonate of barium and calcium would be precipitated, and the barium carbonate so formed would serve to remove the calcium and magnesium sulphates.

None of the authors except Mr. Heastie replied to the discussion. Referring to Mr. Adams' remarks, he said that the Kestner Engineering Company had had much experience with cases of boiler corrosion of the type mentioned. Some time ago it had placed on the market a plant designed to deal with the treatment of such water. In this plant the water was passed through a layer of manganese steel shavings. After this treatment the water was found to have its average oxygen content reduced to under 0.1 c.c. per litre. The treatment had effected a complete cure of the trouble, for corrosion in boilers had generally been traced to an excessive amount of oxygen in the water.

Mr. Newton, who was called upon to reply to Miss Snowden, explained the system of analysis he generally adopted, and, in connection with Mr. Adams' remarks, said that if the water contained as little as ¼ grain of carbon dioxide per gallon, that amount would be quite sufficient to account for the corrosion.

The Delft International Conference on Applied Mechanics.

THE following provisional programme of the International Conference on Applied Mechanics, which opens at Delft on April 22nd, has been issued by the organisers.

Tuesday, April 22nd, 8 p.m.—Opening of the Conference.

Wednesday, April 23rd.—First general meeting devoted to the theory of elasticity and related subjects.

Thursday, April 24th.—Meetings of the sections.

Friday, April 25th.—Second general meeting devoted to hydro and aerodynamics.

Saturday, April 26th.—2 to 3 p.m.: Meetings of the sections. General meeting (business matters, publications), and closure of the Conference. 3 p.m.: Ordinary meeting of the Nederlandsche Natuurkundige Vereeniging, to which the members of the Conference are kindly but unofficially invited.

Monday, April 28th.—Excursion to Eindhoven to visit the "Philips Gloeilampenfabricken" and the physical laboratory annexed to them. Messrs. Philips having invited the members of the Conference and having offered a luncheon and free travel from Delft to Eindhoven and back.

REVIEWS TO BE READ AT TH GENERAL MEEETINGS.

Professor Ir. C. B. Biezeno w.i., Delft: "Graphical and Numerical Stress Determination in Beams and Plates."

Professor Dr. E. G. Coker, London: "Optical Stress Determination." In the course of the discussion following this lecture, Dr. A. A. Griffith will briefly explain the use of soap films in solving stress problems.

Professor Dr. L. Prandtl, Göttingen: "Spannungsverteilung in Plastischen Körpern."

Dr. A. A. Griffith, Farnborough, Hants: "The Theory of Rupture," with some experiments.

Dr. G. I. Taylor, Cambridge: The Hydrodynamics of Rotating Fluids," with experiments.

Professor Dr. Th. von Kármán, Aachen: "Die Stabilitatsfragen in der Hydrodynamik und die Theorie der Turbulenz."

Professor Dr. J. M. Burgers, Delft: "The Motion of a Fluid in the Boundary Layer along a Plane Surface."

Professor Dr. T. Levi-Cività, Rome: "Détermination Rigoureuse des ondes Permanentes d'Ampleur Finie—I." (Sous réserve.)

Ing. E. Hogner, Stockholm: "Theorie der Schiffswellen."

Sir Napier Shaw, London: "The Physical Structure of the Atmosphere regarded from the Dynamical Point of View."

SECTION I.

Professor Dr. H. Alt, Dresden: "Kinematische Synthese (Zusammenfassender Bericht)."

Dr. F. A. Vening Meinesz, Amersfoort: "Déterminations de l'Intensité de la Pesanteur dans les Océans, moyennant des Observations Exécutées dans un Sous-marin."

Professor Dr. B. von Mises, Berlin: "Motorrechnung, ein neues Hilfsmittel der Mechanik."

Professor F. Pfeiffer, Stuttgart: "Sporrungsvergänge bei Raibung starrer Körper."

Mr. H. P. Berlage, Jr. den Haag: "Uber Schwingungen."

Professor T. Tzénoff, Sofia: "Une Forme Nouvelle des Equations du Mouvement des Systèmes non Holonomes et son Application dans la Théorie des Percussions."

SECTION II.

Dr. Ing. Jos. Geiger, Augsburg: "Messgeräte und Verfahren zur Untersuchung mechanischer, technisch besonders wichtiger Schwingungs-vorgänge."

Professor Dr. R. Grammel, Stuttgart: "Knickung von Schraubenfedern."

Professor B. P. Haigh, Greenwich: "Theory of Rupture in Fatigue."

Dr. H. Hencky, Delft: "Zur Theorie plastischer Deformationen und der hierdurch im Material hervorgerufenen Nachspannungen."

Professor Dr. W. Hort, Berlin-Charlottenburg: "Schwingungen von Stäben und Platten."

Dr. G. Masing, Siemensstadt bei Berlin: (*a*) "Uber Anderung des Gesamtvolumens eines Körpers durch innere Spannungen"; (*b*) "Innere Spannungen und Aufreissen von Messing" (Season Cracking).

Dr. Ing. A. Nadai, Göttingen: "Beobachtungen der Gleitflächenbildung an plastischen Stoffen."

Dr. E. Schmid, Berlin-Dahlem: "Neuere Untersuchungen an Metalleinzelkristallen."

Dr. Ing. E. Schwerin, Berlin-Halensee: "Uber ein Thema aus der Elastizitäts-theorie."

Mr. R. V. Southwell, Teddington: "Stress Systems in Solids of Revolution."

Dr. Ing. K. Terzaghi, Constantinople: "Die Theorie der hydrodynamischen Spannungserscheinungen und ihr erdbautechnisches Anwendungsgebeit."

Dr. K. Weissenberg, Berlin-Dahlem: "Zur Theorie über Deformationsstrukturen."

Dr. Ing. Th. Wyss, Danzig-Langfuhr: "Experimentelle Spannungsuntersuchungen an einem hakenformigen Körper." Met lichtbeelden.

Professor H. Reissuer, Charlottenberg: "Uber das Erddruckproblem."

SECTION III.

Ir. A. G. von Baumhauer, Amsterdam: "De Helicoptère."

Professor Dr. V. Bjorknes, Bergen: "Die hydrodynamischen Fernkräfte und deren Zusammenhang mit den Auftriebskräften die Aeroplane tragen," Met experimenten.

Professor A. Friedmann, Leningrad (Petrograd)

"Uber einigen hydrodynamischen Arbeiten Russicher Gelehrter."

Professor E. Hahn, Nancy: "Consideration sur les Turbines Hydrauliques." (Sous réserve).

Dr. Ing G. Kempf, Hamburg: "Ueber den Reibungswiderstand von Flächen verschiedener Form."

Ir. C. Koning, Amsterdam: "Niet stationaire stroomingen om een draagvlak."

Professor L. Marchis, Paris: "L'Etat Actuel en France des Etudes Aerodynamiques."

Professor Dr. Ing. Th. Rehbeck, Karlsruhe: "Die Wasserwalzen als Regler im Energie-Haushalt der Wasserlaufe."

Mr. H. Solburg, Kristiania: "Zum Turbulenz problem."

Professor C. Witoszuski, Warszawa: "Sur l'Insuffisance du Principe de la Circulation dans l'Aerodynamique dans son Etat Actuel."

Professor C. Witoszynski, Warszawa: "La Construction des Profils d'Aviation."

Mr. Nils Zeilon, Uppsala: "Potential Problems in the Theory of Fluid Resistance."

Professor Dr. S. Brodetsky, Leeds: "Vortex Motion."

LAUNCHES AND TRIAL TRIPS.

GLENSMIEL, twin-screw motor vessel; built by Harland and Wolff, Limited; to the order of the Glen Line, Limited; dimensions, 485ft. by 62ft. by 39ft. 6in.; 9500 gross tonnage. Engines, two sets marine oil; constructed by the builders; launch, January 24th.

PORTCURNO, steel-screw steamer; built by Craig, Taylor and Co., Limited; to the order of the Portfield Steamship Company, Limited; dimensions, 392ft. 6in. by 52ft. by 27ft. 8in. Engines, 28in., 42in., 68in. by 48in.; pressure, 180 lb.; constructed by Blair and Co., Limited, of Stockton; launch, February 5th.

CITY OF VENICE, steamer; built by Workman, Clark and Co., Limited; to the order of the City of Oran Steamship Company, Limited; dimensions, 470ft. in length; 8400 gross tonnage. Engines, quadruple-expansion; constructed by the builders; launch, February 6th.

SALMON POOL, steel-screw steamer; built by Irvines Shipbuilding and Dry Docks Company, Limited; to the order of Sir R. Ropner and Co., Limited; dimensions, 403ft. by 53ft. 6in. by 28ft. 9in.; to carry 8600 tons on a moderate draught. Engines, triple-expansion, 26in., 43in., and 72in. by 48in. stroke; constructed by the North-Eastern Marine Engineering Company, Limited; launch, February 6th.

AURANIA, twin-screw steamer; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the Cunard Steamship Company, Limited; dimensions, 583ft. by 65ft. by 43ft.; to carry 14,000 gross tonnage. Engines, two sets of Parsons' steam turbines; constructed by the builders; launch, February 6th.

BARBUS, twin-screw bucket dredger; built by W. Simons and Co., Limited; to the order of the Bombay Port Trust. Engines, two sets of triple-expansion direct-acting surface-condensing, pressure 185 lb.; constructed by the builders; launch, February 6th.

ISLINGTON, single-screw self-trimming collier; built by Swan, Hunter and Wigham Richardson, Limited; to the order of H. Harrison (Shipping), Limited; 2250 tons deadweight. Engines, triple-expansion; constructed by McColl and Pollock, Limited; trial trip, February 7th.

ORISKANY, steamer; built by Swan, Hunter and Wigham Richardson, Limited; to the order of the Ronde Steamship Company; dimensions, 254ft. 6in. by 35ft. 6in. Engines, triple-expansion, driving a single propeller; constructed by the builders; launch, February 8th.

KATHIAWAR, single-screw motor vessel; built by Harland and Wolff, Limited; to the order of Andrew Weir and Co.; dimensions, 384ft. by 48ft. by 36ft.; 4320 gross tonnage. Engines, one set of six-cylinder marine oil; constructed by the builders; delivered February 15th.

ORADELL, fruit boat; built by Swan, Hunter and Wigham Richardson, Limited; to the order of the Ronde Steamship Company, Limited; dimensions, 254ft. 6in. by 35ft. 6in. by 16ft. Engines, triple-expansion; constructed by the builders; trial trip, February 16th.

CITY OF LANCASTER, steel-screw cargo steamer; built by Palmers Shipbuilding and Iron Company, Limited; to the order of the Ellerman Lines, Limited; dimensions, 344ft. by 45ft. by 26ft. 5in.; 5000 tons deadweight. Engines, triple-expansion surface condensing; constructed by the builders; trial trip February 20th.

A.P.O.C. No. 13, oil barge; built by Palmers Shipbuilding and Iron Company, Limited; to the order of the British Oil Bunkering Company, Limited; dimensions, 94ft. by 26ft. 7in. by 11ft. 6in.; to carry about 400 tons of oil fuel. Launch, February 21st.

THE OPTICAL SOCIETY.—At the annual general meeting of the Optical Society, held at the Imperial College on Thursday, February 14th, 1924, the following officers and members of Council were elected to serve for the year 1924–1925:—President, Emeritus Professor Archibald Barr, LL.D., F.R.S.; Vice-Presidents, Sir Frank Dyson, LL.D., F.R.S., Mr. T. Smith, and Inst.-Commander T. Y. Baker, R.N.; Hon. Treasurer, Major E. O. Henrici, R.E.; Hon. Secretaries, Professor Alan Pollard, and Mr. F. F. S. Bryson; Hon. Librarian, Mr. J. H. Sutcliffe, Editor of Transactions, Dr. J. S. Anderson; Council, Dr. J. S. Anderson, Mr. W. M. Brett, Professor F. J. Cheshire, Mr. R. W. Cheshire, Mr. W. B. Coutts, Mr. A. H. Emerson, Mr. H. H. Emsley, Mr. P. F. Everitt, Dr. J. W. French, Miss L. M. Gillman, Mr. J. Guild, Inst.-Lieutenant-Commander N. Langlands, Dr. L. C. Martin, Mr. F. C. Watts, and Mr. A. Whitewell, M.A.

ENGINEERING GOLFING SOCIETY.—The fifteenth annual general meeting of the Engineering Golfing Society was, by permission of the Council of the Institution, held at the Institution of Civil Engineers on Wednesday last, the retiring captain, Mr. S. R. Lowcock, in the chair. The office bearers for the current year were elected as follows:—President: Sir Alexander Kennedy. Vice-presidents: D. A. Stevenson, E. L. Mansergh, F. J. Walker, S. Price-Williams, G. Midgley Taylor, W. H. Shortt, E. W. Timmis. Captain: W. L. Mansergh. Honorary Secretary: G. M. C. Taylor, 36, Victoria-street, S.W. 1. Honorary Treasurer: J. R. Sharman, 6, Queen Anne's-gate, S.W. 1. Honorary Auditor: S. C. Lewis. Members of Committee: H. P. Allison, K. A. Wolfe Barry, A. J. Boyd, E. C. MacKellar, W. A. Tait, A. Valon, and S. R. Lowcock, H. E. Midgley and F. R. Phipps in place of H. G. Hale, C. H. Hayward and E. W. Timmis, who retire in accordance with Rule 5.

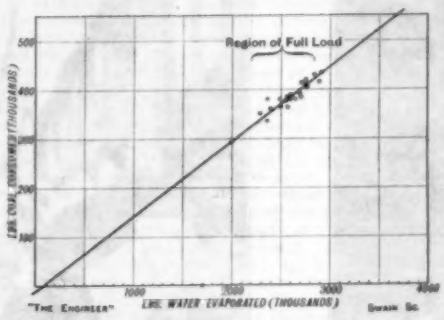
Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE PARSONS' LINE.

SIR,—The whole argument in the controversy between Mr. Napier and Mr. Swindin on the application of the Parsons' Line to the Lakeside figures depends on the method of plotting the line. Mr. Napier plotted the points from the figures supplied in Mr. Brownlie's paper, and unfortunately the figures covered only a small range, somewhere in the region of the full load capacity of the boiler.

I have taken the liberty of plotting the Dalmarnock figures under practically the same conditions, that is by plotting the results of tests when the boilers were working at full load capacity,



and, disregarding the points obtained at lower loads, have drawn a straight line through the mass of points in as fair a manner as possible.

It will be seen that the Dalmarnock plant also produces steam with no consumption of coal. The conclusions which may be drawn are, that the Parsons' Line is not absolutely a straight line; that it is not exactly wise to attempt to draw a line through a small group of points which do not cover a wide range on a graph and which are situated some distance from the origin, and expect to deduce the value of the constant of the curve with any accuracy or even to find whether the constant is positive or negative. R. LEACH.

Acton, February 21st.

[Mr. Leach appears to have taken the lowest and the highest point and drawn the line through them. His line is certainly not the one we should have selected as lying fairly between the dots. We agree that the range for the Lakeside curve is undesirably short; but in view of the extreme accuracy of the tests—see the table—deductions from it are justifiable.—ED. THE E.]

SIR,—I expected that a study of Fig. 2, on page 128, would have explained the impossibility of applying the Parsons' Line to Mr. Brownlie's figures of one single boiler. This graph shows that the real coal-water line as derived from the efficiency curve is not straight, and that it passes through the five points fairly, thus disposing at one stroke of all discussion as to correct constants and inclinations of straight lines. If the efficiency line be derived from a straight Parsons' Line, it will be seen that at high duties it proceeds to infinity at a value of $y = m x$. This, of course, is impossible in the case of a single boiler. When a boiler is forced the efficiency falls, showing that the Parsons' Line must curve upwards as in Fig. 2, page 128. Your editorial, however, supports Mr. Napier's contention that because the Parsons' Line gives impossible results, therefore the original figures are incorrect. This conclusion, of course, depends on the use of a straight line the straightness of which is based on "a large mass of experience." I am not aware of such a mass of information having been compiled from tests on single boilers. Perhaps some of your readers will publish such results and let us have the coal-water lines plotted therefrom. You admit that if the American engineers contend that the Parsons' Line is curved their position is defended. I agree with you that the matter cannot be left where it is, and I hope that Mr. Brownlie will be able to give us particulars of tests taken specially to determine the true form of the Parsons' Line.

London, February 21st. NORMAN SWINDIN.

ENGINEERING HISTORY.

SIR,—Under this caption I solicit the hospitality of your columns to discuss a phase of engineering study that is, apparently, being pushed more and more into the background. In many other branches of activity and learning a perennial interest is maintained in the traditions and monuments of the past, and encouragement is given to the student to become versed, for his own culture and edification, in the history and evolution of this particular science. But the young engineer generally emerges from his pupilage with a complete ignorance of the lives and achievements of those who should be his vocational godfathers, unless he has a native instinct to probe those matters for himself.

It may be argued that an engineer in his years of training already finds himself hard put to it to assimilate the theory and practice of a highly technical profession or industry. It may be said further that an adequate knowledge of present-day technique will satisfy most men provided they are thereby enabled to earn a decent livelihood. Like the schoolboy they cannot see the use of history. But these arguments do not dispose of the question. Take the case of the man whose special province is the steam engine. He may have approached and mastered his subject through the dusty avenue of thermodynamics and have all the considerations which affect design at his finger ends. But it is surely undeniable that if he were also thoroughly versed in the history and evolution of his prime mover and intimate with the lives of Newcomen, Watt and Stephenson, he would be a greater ornament to his profession, and his whole attitude towards it would be more informed and sympathetic. Similarly, his electrical colleague might feel himself born again by a perusal of the life of Faraday. It is surely a misfortune that such excursions into engineering culture have often to start in the musty atmosphere of a second-hand book shop.

Engineering literature of this quality is anything but prolific, and the writers of text-books do little to atone for the want. They invariably bring the student up to his subject with a jerk and souse him in its technicalities without preamble. If they but realised it they might often awaken a healthy interest in an otherwise dry theme by paying some attention to what had been done by those who had gone before. In a recent work on the internal combustion engine, for example, the word "Otto" occurs but once. One of our big dailies is, therefore, to be excused, when reporting a recent speech, for printing "auto-cycle," evidently in the belief that a machine was referred to and not the idea of a gentleman called Dr. Otto.

Had it not been for the literary enterprise of Dr. Smiles, we should probably be in a deplorable state in regard to the life work of some of our greatest engineering geniuses. As it is, the surface is little more than scratched. Recently I have looked through a well-known encyclopædia which purports to be a work of reference to everything under the sun, and find that engineering items of historical interest are either poorly done or omitted altogether. Thus, Captain Savery and Professor Rankine go unmentioned, while biographies of more obscure men in other walks of life abound, including comedians and prize-fighters of past days. Again, ask some of your engineering friends who invented the safety valve, or who discovered electro-magnetic induction, and they will probably be at a loss to say anything of the circumstances connected with these matters.

Surely it is the business of engineers themselves to keep the memory of their illustrious men green, and to place before the tyro some of the interesting anecdotes of the past that will serve to give relish to his drier studies. An appeal for these things is neither sentimentality nor faddism. Neither is it suggested that it is the business of a technical journal to embark upon such pursuits, although it could render much service by calling attention to the publication of engineering literature of this nature.

Glasgow, February 25th. ALEXANDER MCLEAN.

[We need scarcely say we are heartily in accord with Mr. McLean in his plea for greater attention to the history of engineering and science. The many articles on history which have appeared in our pages are sufficient evidence of our belief in the value of such material. We may, perhaps, remind Mr. McLean that a society now exists for the purpose of encouraging historical studies of the kind—The Newcomen Society for the Study of the History of Engineering and Technology, of which Mr. H. W. Dickinson, Science Museum, South Kensington, is the Secretary.—ED. THE E.]

THE SEVERN BARRAGE SCHEME.

SIR,—The revival of the proposed Severn barrage scheme is a matter which should call for more information as to its practical possibilities, since it has previously received much adverse criticism, and I have raised some questions on a former occasion which have never been answered.

The idea as applied to the Severn Estuary has, of course, been suggested by the abnormally high tides; but the confirmation is totally against any economical system of barriers of sufficient strength to stand either the tides or the reverse pressure caused by the enormous mass of water held in check. No explanation has been given as to how a permanent basin of 27 square miles is to be maintained sufficient to float the largest vessels, and at the same time to be utilised for power purposes by letting down the water through turbines.

The idea of a railway and road across the estuary should stand upon its own merits as a paying proposition, and, judging from the plan published, it does not seem to be the intention that it should, in itself, constitute a sufficiently strong or effective barrier.

It was also proposed to use part of the power in pumping water up into a reservoir in the interior of the country, so that it could be run down and used for power purposes when the tidal waters were idle—a crude idea altogether. If any real advantage, why not make a barrier higher up on the river Wye itself?

There are, as a matter of fact, many other estuaries in the South of England, in Wales and Scotland, which, owing to certain natural advantages in the way of narrow outlets, lend themselves to a more economical and practical solution of the problem of making use of tidal waters for power purposes. Why are these neglected in favour of such a hare-brained scheme as that of the Severn?

February 26th. ECONOMIST.

PLANING MACHINE DRIVE.

SIR,—We were interested to read Messrs. Adamson and Co.'s letter in your issue of the 1st inst. advocating the direct electric drive as against any system of clutches, and although we hold no brief for clutches, we are decidedly of the opinion that the magnetic clutch class of planer drive can more than hold its own with the direct electric drive.

What is it that designers of planer drives during many years have aimed to achieve? We think there is no doubt that it is the reduction of the inertia of the moving masses to a minimum. The ideal is, of course, to have no reversing mass other than the table, the rack pinion and shaft and the necessary means for coupling the drive to it. The whole question of "over-run" and planing "to a line" is bound up with this question of inertia, and we fail to see how the direct electric drive, with its armature inertia many times greater than the inertia of the table itself, can achieve this object without dynamic braking and a consequent waste of power.

The application of a drive to a planer is based upon two things:—(1) The strength of the planer gearing, &c.; (2) the most suitable cutting speed for the material to be cut, and any conversion figures must be considered with these points in view.

FOR NEWTON BROTHERS (DERBY), LIMITED.
F. NEWTON.

Derby, February 20th.

LOCOMOTIVES FROM GERMANY.

SIR,—With reference to your leading article on the subject of locomotive engines for the Indian Government placed in Germany, I would like to draw your attention to the fact that it is a requirement of the Government of India that tenderers should sign a statement headed "National Scheme for the Employment of Disabled Men: Is Your Name on the King's Roll?" I presume the German firm receiving the order will have been asked to sign this statement, though, in their case, I presume, it will refer to disabled Germans and not to disabled Britishers. The humour of the situation will doubtless appeal to you.

February 23rd. LOCO. BUILDER.

TAMPING AND CONCRETE BREAKING MACHINE

B. JOHNSON AND SON, ILKLEY, ENGINEERS

A Tamping and Concrete Breaking Machine.

In our description of the Public Works, Roads and Transport Exhibition, which was held at the Agricultural Hall, Islington, towards the end of last year, we made brief mention of the tamping and concrete breaking machine which was shown in operation by Messrs. B. Johnson and Son, of Wharfedene, Skipton-road, Ilkley, Yorks. This firm has recently introduced a small size of this machine, which is illustrated in the accompanying engravings, and which is known as the "Baby." The actual machine shown was supplied to the York Gas Company, and in the views reproduced it is seen at work in the streets of York, where it is employed for opening up trenches for the laying of gas mains and thereafter for tamping solid the filling-in material. This size of machine is intended for trenches up to 2ft. wide, and we are informed that it is capable of breaking up 30ft. run of concrete 2ft. wide and 9in. thick per hour.

The machine can be mechanically propelled, so that, as it does its work it can be made to advance, and it can, so the makers assure us, be easily moved forward and operated by one man. It is of very light construction, as it can well be, since the work it does is carried out with practically no stresses on its frame. All that it is called upon to do is to lift a wood tamping board and let it drop again; it is the force of gravity which does the work, as is the case in pile driving. The carriage or truck is built up of steel angles stiffened with angle bracing and web plates. The two front wheels, which are 36in. in diameter and have a face 6in. wide, are of wrought iron. They have an extra tire 3in. wide in the centre of their width, so as to render them suitable for either soft ground or hard surfaces. The rear wheels are of smaller diameter and not so wide in the face as the others. All the four wheels can be adjusted vertically, so that, when the machine is required to work on any unlevel surface, the wheels can be so adjusted that the tamping board may always be vertical. For example, two wheels may run on the road and two on the footpath.

The travelling motion is brought about by spur gear and pinion to each of the larger wheels, which is driven by intermediate differential gear, which, in turn, is driven by a sprocket and roller pitch chain, the whole—for quick travelling—being actuated by handles at the rear end of the carriage. There is an extra slow motion which is effected by worm gear, and which is specially used for tamping. The slow travelling motion is so arranged that it can be worked either from the end or from either side of the machine, as may be desired.

The portion of the machine which embodies the lifting mechanism and carries the tamping board, and which is termed the swivel, is made up of steel channels, and is supported near its centre on a saddle casting which is mounted on the carriage and which has a pivot bearing on the axle. This saddle casting is so arranged that it can be made to slide across the carriage by means of a nut and screw, which moves the pivot into the position required, so that the machine can tamp either astride or on either side of the trench. The carriage is so built that it provides a support for the tail end of the swivel in whatever position it is required to work, and in operation the swivel is turned backwards and forwards from side to side as the machine is advanced, so that the whole area being tamped or broken up is covered by the tamper or the chisel, as the case may be, all the operations being controlled by one man, as already mentioned.

The motive power which actuates the tamping mechanism is provided by a small paraffin or petrol engine. The drive is by belt through spur gearing. The lifting of the tamping board is effected by means of parallel pulleys with corresponding portions of their circumferences cut away. These pulleys are pressed against the board by means of coiled springs, the tension on which is adjustable. The friction of the intact portions of the pulleys against the board is sufficient to lift the latter as the pulleys revolve. When, however, in the course of the revolution of the pulleys, the cut away portion is reached, there is no longer any friction to act on the tamping board, which, in consequence, drops by its own weight, to be lifted again when the intact portions of the pulleys again grip it, and so on.

The lifting board is of seasoned ash, reinforced by a steel channel on each side. It slides in long steel guides. When the machine is not at work the board is held suspended by means of two excentric grips, which are keyed on shafts carried in bearings, and are actuated by a bell crank lever. Normally these grips are pressed against the lifting board by a small steel spring acting on the bell crank, but when the lifting board is in motion they are held out of contact by a small rod and latch which is arranged handily for the operator. When it is desired to stop the action of the lifting board without stopping the engine, the latch is pushed forward so that the grips are allowed to press against the board and prevent it from falling. The result is that the board is lifted still further by the friction pulleys as they revolve. Since, however, the board is lessened in thickness towards its lower end, a point is eventually reached where the pulleys can no longer grip it, and it is, thereafter, held suspended by the excentric grips until they are released by the operator.

It is claimed by the makers that with their machines a given piece of work is done in one-third the usual time and with a considerable saving in labour cost in consequence. It is further claimed that, as the refilling material is so solidly rammed, paving can be re-laid immediately with confidence that there will be no subsidence. As will be seen from one of the engravings, the street in which the work is being carried out is very narrow, so narrow, in fact, that if any portion of the paving is taken up, it is necessary to close it to traffic. It is pointed out by the makers that the ability to do the excavating work quickly reduces the time during which narrow streets have to be closed and the public inconvenienced. We are informed that during a working day the fuel consumption is about 1½ gallons of petrol.

PURCHASES FOR INDIAN RAILWAYS.

In Vol. II. of the report for the year 1922-23 of the Indian Railway Administration, just to hand, is a table which is exceedingly useful at this time when the question of purchasing for the Indian railways is under discussion. It shows the value of the stores purchased by the principal Indian railways during the financial year ended March 31st, 1923, divided under three heads:—(*a*) Stores imported direct; (*b*) imported stores purchased in India; and (*c*) stores of Indian manufacture or of indigenous origin. We reproduce the summary for these

	Imported direct.	Imported purchased in India.	Indian manufacture or of indigenous origin	Total.
	Thousands of rupees.			
Bridge work	49,56	99	2,35	52,90
Engineers' plant, excluding petty tools	14,49	7,71	82	23,02
Workshop machinery and heavy tools	40,39	10,57	1,03	51,99
Permanent way—				
Rails	75,38	6,51	73,68	1,55,57
Steel sleepers	62,49	—	—	62,49
Cast iron sleepers	84,88	—	3,93	88,81
Wooden sleepers	95	10,79	3,24,03	3,35,77
Chairs and fastenings	53,51	7,93	49,60	1,11,04
Rolling stock—				
Locomotives and spare parts	3,53,03	8,24	5,04	3,66,91
Coaching stock	50,46	2,21	13,77	66,44
Goods stock	1,35,04	3,89	21,02	1,59,95
Spare parts coaching and goods stock	3,88,65	45,70	16,68	4,51,03
Motor cars	1,33	1,65	3	3,01
Building and station materials and fencing	24,29	21,21	12,50	58,00
Tools and stores—				
Tools and cutlery	16,75	12,76	1,94	31,46
Steel, excluding permanent way material	30,30	20,84	6,23	57,37
Iron, excluding permanent way material	22,55	14,92	48,54	86,01
Other metals	20,93	18,55	5,32	44,80
Timber	—	7,56	78,59	86,15
Oil	7	92,50	47,47	1,40,04
Portland cement	1,74	3,21	5,38	10,33
All other stores	1,72,23	1,86,62	1,98,05	5,56,90
Electrical plant and materials	57,34	28,29	70	86,33
Total	16,56,37	5,12,65	9,17,30	30,86,32
Percentage of whole	53.67	16.61	29.72	

thirteen railways, and have added a total column and the percentages of the whole for each heading.

The sums given are in thousands of rupees, and as the value of the rupee is now calculated as ten to the £1, the amounts are for hundreds of pounds. It is thus seen that the amount involved is over thirty million pounds a year. Of this sum just over 70 per cent.—53.67 per cent. directly and 16.61 per cent. indirectly—was expended on imported goods. Next to unspecified stores the highest item was for spare parts for carriages and wagons. It is noteworthy that almost as much was spent on wooden sleepers as on locomotives.

CONTRACTS.

JOSEPH KAYE AND SONS, Limited, of Lock Works, Leeds, inform us that they have received an order from the Director of Army Contracts for the supply of 2400 of their half-pint patented seamless serrated steel oil feeders.

WILLIAM BOBY AND CO., Limited, have received an order from a large firm of dyers for the supply of one of their "Boby-Azed" water-softening plants for treating 300,000 gallons per day of water and bringing its condition to "zero."

CLAYTON AND SHUTTLEWORTH, Limited, Lincoln, in addition to the several contracts for water-tube boilers recently received, have now been successful in securing an order for additional boiler plant for the Ipswich Corporation power station.

ARRANGEMENTS having been made between Yarrow and Co., Limited, of Glasgow, and the De Schelde Company, of Flushing, Holland, under which the latter firm will build the Yarrow (land type) boiler, we understand that it has already received an order for an installation of Yarrow boilers for the central power station at Geertruidenberg, Holland.

AN extensive contract for the supply and installation of power and mechanical signalling on the existing line between Harrow Station and Rickmansworth, on the Metropolitan and London and North-Eastern Railways, and on the new extension from Rickmansworth to Watford, has been awarded to the Westinghouse Brake and Saxby Signal Company, Limited.

THE VICKERS-SPEARING BOILER COMPANY, Limited, of Bank Buildings, 20, Kingsway, W.C. 2, has recently received orders for four Spearing boilers for the Anglo-Scottish Beet Sugar Corporation, Limited, in connection with the new beet sugar factory it is erecting at Nottingham, and for two boilers for Le Matériel Téléphonique to be installed in its new factory at Boulogne-Sur-Seine.

DANIEL ADAMSON AND CO., Limited, Dukinfield, have received from the War Office authorities at York, a repeat order for two sets of sewage lifting pneumatic ejectors of their patented War Office type. These ejectors are to be coupled up to similar machines supplied ten years ago for the drainage of Strensall Camp, near York. The same firm has also received from Hobart City Council, Tasmania, an order for four sets of sewage lifting electro-pneumatic ejectors of their patented "Float-switch" type. The compressors will be motor driven and will be automatically controlled by means of snap-action float-switches, which start and stop the motors at predetermined sewage levels. These plants are to be used in the Queenborough low-level area of the city.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. T. G. HOWES THOMAS, late of 47, Victoria-street, Westminster, has opened an office at 3, Queen Anne's-buildings, Baldwin-street, Bristol.

WRIGHT MOTORS, Limited, of Century Works, Halifax, inform us that it has appointed Mr. H. C. Amos, A.M.I. Mech. E., of 22, Martin-lane, Cannon-street, E.C. 4, its sole London and district representative.

THE death at the age of eighty-one is announced of Mr. J. O. Brettell, one of the founders of the firm of J. O. Brettell and Co.' constructional and general engineers, of the Foregate, Worcester. The business will be carried on at the same address by Mr. J. O. Brettell, jun.

WE are informed by Etheridge, Dewar and Co., Limited, of 10, Byward-street, E.C., that they have been appointed by Burmeister and Wain, Limited, of Copenhagen, as their agents for Liverpool and the whole of the South of England for ship repairs and new construction.

WE are asked to state that Messrs. T. S. Pulford and Sons, late of 77, Cannon-street, E.C., paint, colour and varnish manufacturers, have amalgamated with Endurite (1921), Limited, and that their works and offices are now at Atlas Works, Hatcham-road, London, S.E.

WE are informed that Messrs. Joy and Harrison have mutually agreed to dissolve their partnership as from January 31st last. Mr. Harrison will carry on his practice at Room No. 602 (the offices of the late partnership), and Mr. Joy will practise at Room No. 514, both at 168, Regent-street, W.

SIEBE, GORMAN AND CO., Limited, of 187, Westminster Bridge-road, London, S.E. 1, inform us that they have just received advice that their "Proto" self-contained breathing apparatus has passed the United States Government Bureau of Mines test, and is now a permissible mine rescue breathing apparatus for use throughout the United States.

THE CONSOLIDATED PNEUMATIC TOOL COMPANY, Limited, of Egyptian House, 170, Piccadilly, London, W. 1, asks us to announce that it has changed the address of its Cardiff office to No. 18, Bank Buildings, 98, St. Mary-street, Cardiff. Telephone: Cardiff 256. Telegraphic address: Caulking, Cardiff.

INDIAN BOILER REGULATIONS.—There has been recently issued from the Government Press at Simla (price one rupee six annas) the regulations for boilers for use in India under the terms of the Indian Boilers Act of 1923, which, presumably, is to come into force at an early date, if it has nor already done so within the past few weeks. These regulations, which may be quoted as the Indian Boiler Regulations, 1924, are very full, and should, of course, be in the hands of all firms in this country who export boilers to India. The Act extends to the whole of British India, including British Baluchistan and the Santhal Parganas.

THE INSTITUTION OF MINING AND METALLURGY: AWARD OF GOLD MEDAL.—The Gold Medal of the Institution of Mining and Metallurgy—the premier distinction within the gift of the Institution—has been awarded conjointly to Mr. Herbert William Gepp, M. Inst. M.M., and Mr. Gilbert Rigg, M. Inst. M.M., in recognition of their joint and individual services in the advancement of metallurgical science and practice, with special reference to their achievements in the treatment of complex sulphide ores, and in the development of the electrolytic process for the production of zinc in the Commonwealth of Australia.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Return to Work.

THE dockers' return to work and the slightly more hopeful general outlook infused more cheerfulness into the weekly meeting of the Birmingham iron trade to-day—Thursday—than has been the case of late. The strike did not last long enough seriously to affect this district. There was, for the time being, a cessation of imports from abroad, but no stringency was created on that account, stocks in hand being sufficient in the majority of cases to tide users over the brief period of the strike's duration. A further week's stoppage, however, would have made all the difference. Mills would have been congested with material awaiting shipment, and supplies of foreign ore, extensively used in steel production, would have run short at a proportion of the furnaces. One compensation of the stoppage has been the liberation of railway trucks to transport fuel and material overdue through the shortage of trucks, especially products of long lengths calling for special vehicles. A few re-rolling mills using Belgian semi-finished steel were getting short of billets, so much being held up at the ports through the rail strike. Good tonnages of these have been moved this week, and the position in South Staffordshire, so far as the supply of re-rolling material is concerned, is practically normal. Local agents did not cease, during the dock hold up, to book orders for Belgian material, though, of course, these were accepted without engagement. Foreign prices are still attractive, but consumers are cautious in placing orders, in view of the great uncertainty in regard to time of delivery. The low state of continental currencies, however, constitutes a serious menace to Midland steel works, and though as yet blast-furnace owners in this area have not been affected by the continental pig iron which is coming into this country, there is a threat that even the barrier of high railway rates which at present protects the Midlands, will be surmounted, and foreign pig iron offered on the Birmingham market at at least competitive prices. It is feared that continental competition must continue for several months.

Staffordshire Iron Trade.

The Staffordshire finished ironworks are fairly active, but the general trade depression is indicated by the closing of a large ironworks near Stourbridge, which has been in practically continuous operation for a century, and is now to be dismantled. There is a good deal of idle plant still in the Black Country, for work is unevenly distributed. The marked bar mills are working full time, and there is some little reserve of orders in hand. The £14 10s. standard, which was fixed in April last year, is continued. Makers of crown bars experience some difficulty in raising prices above the long standing figure of £12 10s., but they continue to quote £12 15s., and some firms will not depart from this figure. A somewhat hopeful development is the buying of bars by country districts, largely to meet agricultural requirements. Orders received from provincial warehouses have been better lately than for many months past. This is a matter of some importance to Staffordshire, which is the most usual source of supply to the large Midland dealers re-stocking these warehouses. In spite of keen competition with No. 3 Belgian nut and bolt iron at £8 15s., many Staffordshire makers refuse to go below their recent quotation of £11 15s. Other firms, however, are stated to be still selling at £11 10s. Lancashire makers make £12 a firm minimum, and most houses demand £12 5s. The dockers' strike was not of sufficiently long duration to affect materially imports of Belgian bars beyond causing delay in deliveries. Orders for these are accepted roundabout £8 15s. delivered. Some business has been put through this week at half-a-crown less. Although they are less dependable in some respects than native bars, the difference in price is regarded as compensation for any wantage. The tube trade is a bright spot in the market, and there is a corresponding activity in strip, both iron and steel. Wrought iron gas-tube strip is quoted by many makers at £13, but it is still possible to buy in some quarters at £12 17s. 6d.

Raw Iron.

There are no new developments in the Midland raw iron situation, nor has any fresh light been thrown on the probable course of future events. Some furnacemen are hoping for slight concessions in coke, now that the active buying from the Continent has somewhat relaxed. But, for the present, coke is in anything but plentiful supply and, as I pointed out in my last letter, the indications are that coke prices will advance when they are reviewed at the end of March. Derbyshire and Northamptonshire pig iron producers have again this week successfully resisted the efforts of consumers, who, pointing to the recent fall in values in the Cleveland market, have endeavoured to secure tonnages at lower prices. The amount of business passing is of limited tonnage, a course which, in the present uncertainty, seems to meet with the approval alike of producers and consumers. Prices are held more because production costs will not permit of any reduction than by reason of demand, which is on a retail scale at the moment. Northamptonshire No. 3 foundry iron continues at £4 13s. 6d. at furnaces, and forge qualities command £4 6s. 6d. Derbyshire No. 3 foundry is mostly sold at £4 15s., with a range up to £4 16s. 6d. Forge has been quoted as high as £4 12s. 6d., but consumers say they have little difficulty in securing supplies at £4 7s. 6d. North Staffordshire makers continue to quote £4 17s. 6d. upwards for foundry sorts and £4 10s. upwards for forge.

Steel Business.

The large steel works in the Midlands are fairly supplied with orders, and have not found it necessary to reduce the standard prices. The market, however, is not quite so strong as it was, partly owing to the sale of second-hand material by merchants, and partly to the very low prices which continental houses continue to quote. The much-needed price advances enabling native steel makers to obtain a small margin of profit, are regarded as out of the question at present. The abnormal conditions following the strike render difficult any forecast, so many contracts being held up by cautious buyers uncertain as to the future trend of prices. There was on Birmingham Exchange to-day—Thursday—however, a noteworthy increase of inquiry by general merchants and buyers. Shipbuilding demands are expanding, and the steel required for bridge contracts, various constructional enterprises, and railway needs will keep the steel works occupied for some time. English billets are selling at about £8 with some works quoting 5s. to 10s. over this price. The Welsh steel works are so busy with general orders supplying the necessary semi-finished material for the sheet and tin-plate trades, that they are practically out of the competition for Midland business. It is still possible to buy Belgian billets at under £6 15s., and large quantities continue to come into the district for the use of local re-rollers. The ability of home concerns to give quick deliveries is an important element in enabling them to resist foreign competition.

Scrap.

Foreign competition in steel scrap is as keen as ever, and home sellers have this week been forced to accept as low as £4 5s. per ton if they wished to sell. This is fully 5s. per ton less than holders were prepared to do business at a week ago. Wrought iron scrap is scarce, and prices have improved somewhat.

Testing Manufacturers' Materials.

An addition of some importance to Midland and Black Country manufacturers has been made to the apparatus of the Industrial Research Laboratories of the Birmingham Gas Department. The new 100-ton tensile testing machine has been installed. Use is being made to an increasing extent by manufacturers and others of the laboratories, and a considerable demand for facilities for testing the strength of various materials has to be met, and, although a 25-ton machine was installed for this purpose in 1917, it was found inadequate to meet all the requirements of manufacturers, and the 100-ton machine was consequently acquired. The machine has been so arranged as to be available for a considerable variety of tests, and is fitted with three travelling poise weights, which can, if desired, be so inter-connected as to enable the capacity of the machine to be 25, 50, or 100 tons respectively, three separate scales being fitted to the beam for this purpose. The effective space between the grip holders is very considerable, which permits of large specimens being tested, and, owing to the particular arrangement of the moving crosshead holding the bottom jaws, the apparatus can be used either for compression or tensile testing, no change over of gear being necessary. A complete set of tools is available for bending, and a massive bending beam is slung from the top knife-edge for this purpose, being so arranged as to allow a load of 100 tons being applied at the centre of the specimen, which is mounted on cylindrical seated supports up to 5ft. centres. The machine is one of the largest of its kind in the country, and local manufacturers much appreciate the facilities which have been afforded by the Birmingham Gas Department.

Edge Tool Works Busy.

The edge tool industry in the Black Country shows increasing activity, and at the moment many of the bigger firms are remarkably busy. Orders, though numerous, are, however, on the small side, and are for quick delivery. Manufacturers indeed are being "rushed," and only with difficulty are they executing orders at a speed satisfactory to customers. The Indian market is the brightest at the moment, and is providing a goodly proportion of the business. Increasing demands are, however, being received from Brazil, the Phillipines, Singapore, British East Africa and South Africa.

Unemployment.

There has been a further substantial decrease in the number of persons unemployed in the Midland area. According to returns, the number out of work for the week ending February 18th was 142,042, being a decrease of 5288 as compared with the previous week, and 2376 in the past fortnight. Unemployment was distributed as follows:—Men, 101,167; boys, 2717; women, 33,897; girls, 4261.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

THE iron and steel markets are still more or less in a state of suspense, and the volume of business being done in the Manchester district remains small. Some satisfaction has been expressed that the construction of the five warships is to be proceeded with, but this will probably benefit Sheffield more than Manchester. Some increase in the demand for steel may result, but it is clear that the steel trade needs very much more work than can be provided by Government orders. The state of the steel scrap trade and the low prices for steel-making pig iron are evidence of this. It is to be feared that the present stagnation in buying is not so much the result of any fear that the prices for iron and steel in the Midlands are likely to fall very much; but that there is really no expansion in the order books of consumers, and the fear is that the volume of work will continue to dwindle and that buying is only safe where there is a certainty of prompt consumption.

Metals.

So far as can be seen the recent advance in the copper market is not, as was at first hoped, the beginning

of a steady rise which would bring copper prices into proper relationship with tin, lead and spelter, but merely a temporary movement like those with which we have all been familiar during the last two years. The actual production of copper is still in excess of the present consuming power of the world, but not so much in excess as was the case a year ago. In other words, consumption is slowly gaining on the output, but the process is too slow to justify any sudden jump in copper prices, and a movement such as seems now to be coming to an end gives "bears" an opportunity of attacking the market under favourable conditions. Manufacturers of copper sheets and copper and brass tubes took advantage of the better prices for raw copper to advance their prices by £2 per ton on sheets and by ¼d. per pound on tubes. One of the influences which may bring about a better situation in the copper trade is the recovery of Germany. There do, at last, seem to be some chances of this, and, at any rate, of the establishment of a currency on a sound basis. We must, therefore, be prepared for dearer copper in the future, although it may not be for some months. That copper should remain permanently the "Cinderella" of the metals is, of course, impossible, and eventually the old relationship in values will, no doubt, be restored. In the tin market there was a set-back after the advance, but this was only to be expected. Apparently, confidence in the prices has not been destroyed, and there are still a good many people who believe that the market will go to £300 per ton. Certainly, at present, the statistical position of tin is quite good. American experts are saying that there will be a famine in tin, but this is probably taking an exaggerated view of the situation. The market for lead seems still to be increasing in strength. Possibly the effect of the dock strike upon spot prices has to be discounted, but there has been heavy buying of the metal, and, so far as can be seen, the consumption is still well above the production. The unusually high price does not seem able to stimulate the output. Spelter is a fairly steady market, although the demand for galvanising purposes is scarcely so active as it was. Prices have not varied much for the last fortnight.

Pig Iron.

The market for foundry iron here remains very quiet, and almost all the business passing is for small lots. Makers do not see their way to offer any concession on the prices for forward delivery, although they are now more disposed to book forward contracts at spot prices; but consumers, most of whom have a fair supply of foundry iron in hand, are not at all anxious about the future, and will not be so long as Cleveland iron is so easy a market. The ending of the dock strike is, of course, a matter for congratulation in one sense, but there is a way of looking at it which suggests sinister possibilities. The ease with which the dockers have won their game will certainly induce confidence in the possibility of higher wages in all sections of labour just at the time when it is most important for the iron trade that prices should be kept down. Certainly, the prospects for cheaper iron and steel are not assisted by the idea that workers have only to strike to obtain more money. The whole position is extremely uncertain, and if lower prices for iron and steel are to come it will probably be through the pressure of continental competition. Derbyshire No. 3 iron is still quoted here at 102s. 6d. per ton, and there is a little Lincolnshire foundry iron at 104s. delivered. The lower prices for basic pig iron may induce more Lincolnshire furnaces to revert to the production of the foundry quality, and this, of course, will mean greater competition for Lancashire foundrymen's orders. Scotch iron is quiet and rather weak, but there is no change here in East Coast hematite pig iron.

Steel.

The slackness in the steel market continues, and very little business is now being done here. The Association price for joists and angles remains at £10 per ton in Manchester; but this class of steel can be bought here at £9 15s., and probably anyone who had a substantial and good specification to offer might get along at less than this. The continental sellers will now be able to be more precise as to terms of delivery, and they are well able to cut very much below any possible British prices. Common steel plates are usually quoted here at £10 10s. per ton. The demand for manufactured iron is rather better, and certainly not nearly so weak as that for steel.

Scrap.

Heavy wrought scrap iron is now quite a firm market, and most dealers hold out for 105s. delivered at the consumers' works. Steel scrap, on the other hand, is weak and neglected, and only about 90s. delivered in Sheffield can be obtained for it. This means that the dealers have to buy ordinary melting scrap at about 80s. on trucks at a Lancashire station. Of course, if they can get any of it away mixed with wrought scrap, they will do so. There is no change in the foundry scrap market, and no sign of any improved demand. Dealers will sell good broken machinery metal at 90s. per ton, and perhaps at a little less.

BARROW-IN-FURNESS.

Hematites.

The position of the hematite pig iron trade is in no way improved. The uncertainty caused by recent disturbances in the labour world is still marked, and business is only being carried on on a small scale, for there is no disposition on the part of buyers to place orders more than to cover their immediate wants, and forward contracts are quite absent. The make of iron is down by two furnaces as compared with the period of the start of the railway strike. Orders are only fairly held, and the restricted output is just about being used. Overseas business is quiet. Last week a cargo of pig iron left Barrow for America, and a further cargo will be dispatched this week now that the dockers are back at work. Prices are firm and steady.

Iron Ore.

For iron ore the demand is mostly on local account, except that some coastwise shipments are leaving the Hodbarrow mines, and now and again a small lot is sent to the Continent. Last week the importations of Spanish ore were fairly heavy, 12,500 tons reaching Barrow. This ore was held up owing to the dock trouble.

Steel.

There are no new features to report in the steel trade. At Barrow good outputs of rails, hoops and special sections are noted, and a cargo of steel rails has left for Bombay. At Workington the rail mills have been indifferently employed of late, but there has been more activity in the last week. The general demand for steel is quiet so far as rails are concerned, but a steady business is being done in hoops and special sections.

Shipbuilding and Engineering.

In these trades a strike of rivet heaters has been the cause of throwing idle nearly 600 men at the Barrow shipyard. Otherwise there is a fair amount of activity.

Fuel.

For fuel the demand is quiet, both for coal and coke.

SHEFFIELD.

(From our own Correspondent.)

Position of the Steel Trade.

A SOMEWHAT better tone characterises the heavy steel trade of the district this week. There is evidence of a renewed buying movement, in respect of steel, raw material, and fuel, and producers of steel are hopeful of the future, as there is work in progress in many places which will mean a heavy demand for their material. There is not much financial satisfaction about the position, as, owing to severity of competition, business can only be secured at very low prices, which in some cases do not cover costs. Still, the fact that there is an increasing demand is something. During the week two additional furnaces have been started at the Templeborough plant of the United Steel Companies, bringing the number in operation to 8 out of a total of 14, and restoring the output to what it was before the Christmas stoppage, while the melting plant at the same firm's works at the Ickles is almost on full time, and a brisk state of things prevails at Stockbridge. At one or two of the other large steel works, however, things are reported to be rather quieter. The orders on hand for railway steel continue to be a good feature of the heavy side of the trade, and are absorbing a large quantity of acid material. No rapid progress can be reported in the crucible steel trade. It is improving, but has not by any means reached a satisfactory level yet. Large quantities of Sheffield tools are being required in connection with the work given out by Government departments, municipalities and railway companies. The overseas trade is still a weak spot, however. Especially is this the case with the European countries, which, owing to the depreciated state of their exchanges, do not recover their power of purchasing high-grade Sheffield steel, for which they were formerly good customers.

The Cruiser Programme.

Sheffield has not been thrilled by the decision of the Government to lay down five cruisers. The city had been encouraged to hope that eight vessels would be built, but the reduction of the number to five, coupled with the fact that three of them are to be laid down in Government dockyards, greatly alters the outlook. It is hoped that Sheffield firms will share in the contracts for the building of the other two, but, in view of the competition of other centres, that is, of course, not by any means a foregone conclusion. Sheffield will, however, benefit, directly or indirectly, but the effect will not be immediate, and it will not reduce unemployment in the city to the extent that had been hoped.

Cutlery Questions.

Some interesting questions with regard to the cutlery trade have arisen in connection with the grinders' dispute and the new Home Office regulations. The dispute has now been composed, the men having gone back to work and agreed to submit the questions at issue to arbitration, but it looks like having a permanent effect in the increased attention which will be devoted to machine grinding. During the strike cutlery makers have been compelled to take advantage of all the mechanical grinding plant in the city, and additional machines are now on order. In the case of several leading houses, machine-ground blades are now being used for the first time. The new draft regulations as to grinding wheels would, if put into operation, entail heavy expense on the manufacturers, and this consideration is also likely to stimulate machine grinding. A further suggestion is that abrasive wheels shall be substituted for sandstones. This latter idea was put forward at a technical meeting in the city last week, by Mr. E. L. Macklin, Engineering Inspector of Factories, who was jointly responsible, with Dr. E. L. Middleton, for the Home Office report which led to the proposed regulations. He pointed out that abrasive wheels do not contain any appreciable amount of the deadly free silica, and that, as they last from six to ten times as long as grindstones of much larger dimensions, the quantity of dust evolved must be very much less. He admitted that the cost was much greater, but this was compensated for by the longer life of the wheels. Some months ago, he said, a firm of abrasive wheel agents fitted up a hull with these wheels, and invited the interested Sheffield people to try any class of grinding, free of charge. The opinions expressed by practical grinders were entirely favourable. In answer to a question as to fumes given off by the wheels, Mr. Macklin said he was not aware of any, except in the case of abrasives that were mixed with india-rubber. These wheels were known in Lancashire trades as "stinkers." He did not know that they were dangerous to health, but as he was not a doctor he could not say definitely.

Mining Developments.

There is a good crop of news items about mining progress in the district this week. In all directions efforts are being made to increase the coal resources of the country, which, if anticipations are correct, are likely to be severely strained when full industrial prosperity returns. Satisfactory progress is being made with the work of sinking the new Markham Main colliery at Armthorpe, close to Doncaster, which has been in progress since June, 1922. Water trouble has been encountered, but has been overcome by the application of the cementation process. The engine-house and workshops are completed, and the erection of screens and washers is being pushed forward. It is hoped to reach the Barnsley seam in the spring. There is hope of an early resumption of work in the Barnsley bed of the Rotherham Main colliery. The pit was shut down in 1921, as the owners—John Brown and Co., Limited—deemed it inadvisable to continue under the then conditions of working. Since that date a very large sum of money has been spent in improving the facilities for coal-getting, and it is understood that all that now remains, in order to bring about a reopening, is the making of amicable arrangements between the masters and men. In the Mansfield district, operations at Firbeck are proceeding rapidly; it is hoped to have the Blidworth sinking well under way in a short time; the Butterley Company is sinking at Ollerton, and the Bolsover Company has leased a large area of coal at Edwinstowe from Earl Manvers. It is predicted that during the next decade the district within ten miles of Mansfield will see an increase of 100,000 in its population.

Work in Progress.

A set of winding engines for the new Firbeck collieries is in course of construction at the Broad Oaks Ironworks of Markham and Co., Limited, Chesterfield. The members of the Sheffield and East Midlands branches of the Institute of British Foundrymen, who went round the works last week-end, saw the progress that is being made with these engines, and in several other interesting directions. Underground haulage engines—a speciality of the firm to take the place of ponies—were seen in operation under compressed air. Much interest was manifested in a tunnelling shield of the type which the firm is constructing for extending the London tube railways. One of these productions, of the excavator type, was seen at work; it permits of the excavation going on while the trains are running. A Sheffield point of interest is that Hacksaws, Limited, is executing a large continental order for its improved type of hacksaw blades of spring temper. Another satisfactory report comes from Lincoln. The old-established firm of Clayton and Shuttleworth, agricultural engineers, which took up the manufacture of water-tube boilers a year or two ago, has booked, in addition to the contracts which I mentioned last week, an order for additional boiler plant for the Ipswich Corporation power station.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Sydney Bridge Contract.

THE announcement that the New South Wales Government has accepted the tender of Dorman, Long and Co., Limited, Middlesbrough, for the construction of the bridge over Sydney Harbour linking up the North Shore with the City, has given considerable satisfaction in North of England commercial circles. The order will have some beneficial effect on Tees-side, but the firm's enterprises in Australia will benefit most. Dorman, Long and Co. have long had constructional works in Melbourne, and they have been considerably extended in recent years. Tenders for the construction of the bridge were invited from all parts of the world, but the New South Wales Government gave the Mother Country a 10 per cent. preference on materials supplied.

Cleveland Iron Trade.

Quite a listless state of affairs prevails in every branch of the iron and steel trade in the Cleveland district. Any favourable effects of the settlement of the dockers' strike have not yet made themselves felt, and are, in fact, discounted by the apprehensions with regard to the shipyard men's and miners' demands developing into a rupture. Uncertainty prevails all round, and under the circumstances nobody will buy except for immediate requirements. Forward contracts are almost unheard of, and ironmasters are carrying on with no certainty of finding a market for their products. One more furnace has gone out, and another is to go out probably next week, which will reduce the number operating on the North-East Coast to 46, of which 12 are on Cleveland pig iron, 16 on hematite, and 18 on special kinds of iron. A further reduction in prices has been made this week, No. 1 Cleveland now being 97s. 6d.; No. 3 G.M.B., 95s.; No. 4 foundry, 94s.; and No. 4 forge, 93s. per ton. There is one encouraging feature in the position. At the prices named Cleveland can compete with any other British producing area. Even Midlands iron is now on about a par with Cleveland, and it is merely a question of transport costs as to which is the cheaper. Continental iron is, of course, in a different category. Prices for it are still low, but buyers here cannot get delivery and, consequently, on the basis of present prices, Cleveland makers are hoping for an early expansion in the demand.

Hematite Pig Iron.

The East Coast hematite makers, though offering

the cheapest iron in the country, cannot get orders, and are simply marking time. They refuse, however, to cut prices much further, and still quote 101s. per ton for mixed numbers, and 102s. per ton for No. 1 quality.

Ironmaking Materials.

The foreign ore trade is flat and best Rubio nominal at 24s. per ton c.i.f. Tees. Coke prices are still falling, and good Durham furnace qualities can now be obtained at 32s. 6d. per ton delivered at the works.

Manufactured Iron and Steel.

Manufacturers complain of a general depression in the manufactured iron and steel trade. Recent events have destroyed confidence, and although there must be a big volume of work to be given out, buyers are still holding off the market. Meanwhile, works are still executing old contracts, and the mills are running fairly regularly, but new orders are now urgently wanted to replace those nearing completion. Prices are unchanged all round.

The Coal Trade.

Now that the dockers have resumed work and operations at the loading stations are proceeding more smoothly, a brighter view is taken of the prospects in the Northern coal trade, and active conditions are expected to prevail for some time. Fitters point out that, whilst they are heavily booked for March shipments, they have a large number of February orders to fulfil as soon as tonnage comes forward, and that, consequently, there is likely to be a tight squeeze for supplies during March. The resumption of labour by the dockers will, of course, relieve many boats now held up, and fill up colliery turns for two or three weeks ahead. Buyers, however, look at the position from the point that many orders recently filled, or waiting to be filled, are requirements brought forward by the consumers through fear of the strike lasting some weeks, and that the pressure will naturally decrease as soon as the present tonnage is worked off. Still, all the present indications point to an active movement, as all continental centres are pressing for delivery of maximum bookings. Shipments to France and Germany continue briskly, and for Italy many large boats have been stemmed. For March there is no doubt that there is a brisk inquiry, and, should a moderate percentage result in booking orders, the tone throughout March should fully maintain the present level of values. The coke trade is quiet, and business limited by the tonnage shortage. Stocks are increasing, with the result that prices show a marked downward trend.

SCOTLAND.

(From our own Correspondent.)

A Dull Week.

MARKETS were dull throughout the past week. Although negotiations were opened up on the dockers' strike, the situation remained so uncertain that business was still almost impossible so far as export was concerned. Home buyers held off until the effect of the strike on local business was more defined. However, with the trouble settled more normal conditions should be established before the end of the present week. The uncertainty in the coal trade still remains, and is causing a considerable amount of hesitancy in that market, and unsettlement in industrial circles generally, as only few consumers can afford to lay in stocks at the present prices of fuel.

Scottish Shale Oil Industry.

The National Union of Scottish Shale Miners and Oil Workers has sent a deputation to London to interview the President of the Board of Trade with the object of discussing the present condition of the Scottish shale oil industry and, in particular, the feeling of insecurity created among the workers by the annual report of the Anglo-Persian Oil Company. The Government has already been requested to make a complete inquiry into the economic position of the industry in the light of the above report and the low wages at present being earned by the workers.

The Demand for Pig Iron.

The Scottish pig iron market continues in a most disappointing and unsatisfactory position. The home trade is poor, orders being few and for minimum quantities. Foundry iron has been reduced in price, and the tendency is still weaker. Export is practically dead meantime.

Steel Position Unchanged.

Steel makers continue to await the flow of orders from the shipyards. A fair amount of railway work has been placed, but many of the works now find difficulty in securing sufficient new tonnage for forward delivery to ensure employment for a few weeks ahead. Steel plates are very slack, and sectional material only a shade better. Steel sheets are only comparatively active, the home demand being irregular but export fairly good. Prices are all unchanged for home delivery, but easier terms are mentioned in respect to shipping orders.

Bar Iron.

Bar iron makers also report a lack of new business. Buying is very limited, and there is little doubt that the present level of prices is largely responsible. The foreign article was finding a certain amount of favour owing to the terms quoted, but protracted deliveries and inferior material have caused considerable dissatisfaction. Price concessions on the part of the home producer would, in all probability, meet with a speedy response. Re-rolled steel is inactive and also suffers from keen competition.

Coal.

During the whole of last week the Scottish coal trade was under the influence of the dockers' strike. Export negotiations were practically impossible, and only where buyers could guarantee loading was there any business done. These buyers, too, were able to secure easier terms. Shipping on the Clyde was almost at a standstill, the total cargoes dispatched not amounting to 14,000 tons; but on the East Coast the returns were fully as good as in recent times from the Firth of Forth, and showed an increase from Fifeshire. Aggregate shipments amounted to 205,858 tons, against 302,288 tons in the preceding week and 305,263 tons in the same week last year. The bulk of the shipments from the East Coast went to Germany and West Italy. The dockers' strike threw a considerable amount of extra fuel on the home market, and larger deliveries were made to railways, gas and electricity works and household coal depôts. A fair number of export inquiries are in circulation, but owners are not inclined to give concessions and firm business has been hanging fire. With the dock trouble settled, however, selling may brighten up a little, even in view of the uncertainty in the coal trade. Prices are nominally unchanged.

New Coal Seams in Lanarkshire.

Boring operations in Lanarkshire have revealed new seams which are workable, and schemes are in course of preparation for the sinking of new pits. One pit has already been started and more will follow.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

IT is now that the coal trade is feeling the adverse effects of the recent strike of the dockers. Last weekend the dockers in South Wales approved the terms of settlement, and work was resumed at all ports on Tuesday; and incidentally there is plenty of work for them, inasmuch as during the stoppage 108 steamers had accumulated at the various ports on which discharging operations had to be done. It is estimated that the total quantity of cargo which had to be discharged from these vessels aggregated about 150,000 tons, consisting of iron ore, grain, pit-wood, pit-props and general commodities. The coal trade is handicapped because of the shortage of ready tonnage. Apart from the numerous steamers which have to be discharged, owners preferred during the strike to send their boats to continental ports to load, and, in some instances, sent them in ballast to the river Plate rather than run the risk of having their steamers detained in this country, seeing that it was impossible to say how long the stoppage was likely to last. The result is that this week there has been an insufficiency of tonnage, and numerous loading berths have been vacant at the different docks. Stocks of standing coals have been heavy and, owing to the shortage of wagons, a number of collieries have had temporarily to stop working. It is expected that it will take a week or two for the position to right itself, if indeed it does so in that time, as it is not an easy matter to attract tonnage in these days when steamers are more widely dispersed over the globe than has been the case for many years. Furthermore, the inquiry from abroad is not what can be described as active. The termination of the dockers' strike has not been followed by a rush of orders, though there is this to be said, that most exporters have sufficient commitments to discharge to keep them occupied for a time, having been prevented from executing them owing to the operation of the strike and the scarcity of tonnage available.

Colliery Enginemen's Demands.

The national policy on the wages question was discussed at the end of last week by the council of the South Wales and Monmouthshire Colliery Enginemen, Boilermen and Mechanics' Association. The National Federation has decided to apply for a 2s. per day increase on the base rates of all its members in the various districts, and when this increase is agreed, the wages are to be stabilised and not be subject to the fluctuations in percentages, but periodical adjustments should take place in the districts, the periods for these to be arranged by the districts themselves. It was explained that there would not be separate action on the part of the colliery craftsman in South Wales, but that they would act in conjunction with the other districts affiliated to the National Association. It was also made clear that no strike would be authorised until negotiations had been exhausted, both with the Mining Association of Great Britain and the Coalowners' Associations in the various districts.

New Mills.

The announcement is made that the second stage of the development of its Courtybella Works, Newport, is now being proceeded with by the Whitehead Iron and Steel Company, Limited. The first section of this new installation consists of sixteen mills for cold-rolling steel strip, complete with pickling and annealing shops. The mills will be accommodated in an extension, 240ft. long by 95ft. wide, to the present mill buildings, with two separate bays for pickling and annealing. When completed this plant will constitute one of the largest units of its description in the country. It is also proposed to add a department for galvanising hoops. The company has secured recently for its Tredegar works a contract of 8000 tons of ferro-concrete steel for the Great Western Railway Company for that company's extensions at Avonmouth, for which Sir William Arrol and Co. are the contractors.

Ship-repairing.

The ship-repairing industry has shown improvement during the past six months, though the volume of work has varied to a marked extent occasionally, comparing one week with another. Still, the fact remains that the demand for men has steadily expanded, which is a good sign. It is quite true that fairly good contracts have recently been lost to continental firms, and South Wales firms have, in fact, just lost another; but in this instance it has gone to a firm across the Bristol Channel, viz., the Hansen Shipbuilding and Repairing Company, of Appledore. The steamer is the ss. Mallock, which ran ashore at Broaksea Point not long ago and sustained considerable bottom damage. About twenty firms tendered for the work, and when tenders were opened on Saturday last it was found that the order had been secured by the Hansen Company, the price of which was round about £3000 and the time 32 working days.

Current Business.

New business has been on rather moderate lines during the past week and the tone is quiet and easy. Unfortunately collieries have had all their arrangements and calculations upset through the shortage of tonnage caused by the recent strike of the dockers. Their contractors are being pressed to find tonnage to lift their contract coals, but prompt suitable tonnage is very limited in supply, in addition to which rates of freight are unpleasantly high for many exporting firms who before the strike accepted orders based on having to pay much less in freight. Collieries are working irregularly, and loading berths at the docks are easy to obtain at the moment. Coal prices are very uneven and are determined solely by the individual position of the various coalowners. Concessions are readily forthcoming for those buyers who can load promptly and thus aid collieries to tip quickly and provide empty wagons. Both large and small coals are easy for prompt shipment, but for loading ahead colliery salesmen are not prepared to accept low figures. Their view is that before very long a better demand will be seen on account of fears that trouble will be met with in the case of the miners' wage demands. Nominally best Admiralty large are 29s. 6d. to 30s. 6d., and other grades are in proportion, but reductions of 1s. to 2s. can possibly be secured by those buyers who can take immediate delivery of coals. Smalls are in the neighbourhood of 19s. for the best qualities. There is no appreciable change in the patent fuel section. In this connection it is interesting to note that the Crown Patent Fuel Company has re-opened its works at Port Talbot after a lapse of sixteen months, and work was provided on Monday last for about 200 men. Pitwood rules about 33s. to 35s.

Latest News from the Provinces.

NORTH OF ENGLAND.

The Sydney Bridge Contract.

FURTHER details are available in connection with the construction of the bridge at Sydney, the contract for which has been placed with Dorman, Long and Co., Limited. The firm submitted several alternative designs and tenders, and the one selected is for a bridge of a two-hinged arch type, to carry four lines of railway, a roadway 57ft. wide between the curbs, and two footways each 10ft. wide. The contract time for completion is six years. The work will necessitate the laying down of a special yard at Sydney to cope with details beyond the capacity of the existing yard.

MANCHESTER ASSOCIATION OF ENGINEERS.—Last Friday, February 22nd, Professor F. C. Thompson, D.Met., read a paper before the Manchester Association of Engineers entitled "Metallurgical Defects in Engineering Materials." Such defects were divided by the author into three groups, the first being ascribed to faulty composition, due either to an unsatisfactory type of alloy or to impurities present in it; the second group being traceable back to the ingot or casting, or even to the molten metal in the furnace; and the third group to errors in heat treatment, which were the special province of the microscope. The paper dealt chiefly with the iron and steel side of the subject, heat treatment and the uses of the microscope. The author said that the metallurgical microscope, although often dealt with in manufacturers' catalogues as though it were quite a distinct piece of apparatus, need be nothing more than any ordinary microscope stand to which had been fitted a vertical illuminator of any standard type. He said that for high-power photographic purposes the disc illuminator possessed advantages over the prism type, but for visual work at low powers the latter was, perhaps, the more convenient. While the microscope gave evidence of the greatest value concerning the heat treatment of steel, the author warned his audience that it could not always reveal the causes of failure, and gave interesting examples. The paper was illustrated by lantern lides.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—The annual dinner of the Institution of Electrical Engineers was held at the Hotel Cecil on Thursday, February 21st, the chair being occupied by Dr. Russell, who read congratulatory messages from the French Society of Electricians, the American Institute of Electrical Engineers, and the Italian Electro-technical Association. Many distinguished guests were present. In proposing "The Institution," Viscount Chelmsford, First Lord of the Admiralty, referred to the use of electricity on modern battleships, and remarked that the Navy was deeply indebted to electrical engineers. A modern warship, without electricity, was almost inconceivable, and unless submarines had large storage batteries they would be useless. One of the most interesting facts that had come to his notice during the time he had been at the Admiralty was that while there was a department for the development of the submarine, there was also an anti-submarine department, and each department was trying to get ahead of the other. In responding, the President remarked that the activities of the research department of the Admiralty were reflected in the equipment of its latest vessels. Referring to wireless communication, he said that he felt that it was within the power of radio engineers to devise means by which a seaman in a cargo boat or even in a fishing smack would be enabled to determine his position at sea. Mr. F. Gill proposed the toast of "Our Guests," and in doing so touched, among other things, on his favourite subject—telephone communication in Europe. Sir William Clarke, in responding, said that it was through British electrical engineers that we were able to keep our place in the markets of the world. Sir Ernest Rutherford and Colonel Crompton also replied to the toast; whilst Dr. Ferranti, who, as we have recently announced, has been awarded the third Faraday Medal, thanked the Institution for the honour conferred upon him.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	19/6 to 26/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	24/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 8 9	—
No. 1 Foundry	5 7 6	—
No. 3 Foundry	5 2 6	—
N.E. COAST—		
Hematite Mixed Nos.	5 1 0	5 1 0
No. 1	5 2 0	5 2 0
Cleveland—		
No. 1	4 17 6	4 17 6
Silicious Iron	4 17 6	4 17 6
No. 3 G.M.B.	4 15 0	4 15 0
No. 4 Foundry	4 14 0	4 14 0
No. 4 Forge	4 13 0	4 13 0
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 10 0 to 4 12 0	
„ „ Foundry	4 17 6	—
(3) Northampton—		
Foundry No. 3	4 13 6 to 4 15 0	
„ Forge	4 6 6	—
(3) Derbyshire—		
No. 3 Foundry	4 15 0 to 4 16 6	
Forge	4 7 6 to 4 10 0	
(3) Lincolnshire—		
No. 3 Foundry	4 15 0	—
No. 4 Forge	4 14 0	—
Basic	4 11 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 15 0 (a) / 6 0 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 10 0	—
Best „	—	—
N.E. COAST—		
Crown Bars	12 0 0	—
LANCS.—		
Crown Bars	12 10 0	—
Second Quality Bars	11 15 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	12 10 0	—
Best „	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	12 10 0 to 12 15 0	
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	11 10 0 to 11 15 0	
Gas Tube Strip	12 17 6 to 13 0 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 10 0	—
Ship Plates, ¼in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 3/16in. to ¼in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 5 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	9 0 0 to 9 5 0	—
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 5 0†	—
Light „	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
Hoops	14 10 0	—
MANCHESTER—		
Bars (Round)	10 10 0 to 10 15 0	
„ (others)	10 5 0 to 10 7 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	10 10 0	—
„ (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 10 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 10 0	—
MIDLANDS—		
Small Rolled Bars	10 10 0 to 11 0 0	
Billets and Sheet-bars	8 0 0 to 8 5 0	
Gas Tube Strip	10 15 0 to 11 0 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 10 0	—
Angles	10 0 0	—
Joists	10 0 0	—
Tees	11 0 0	—
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	24/3 to 24/9
Block Tin (cash)	280 15 0
„ (three months)	279 10 0
Copper (cash)	63 12 6
„ (three months)	64 7 6
Spanish Lead (cash)	35 15 0
„ (three months)	34 15 0
Spelter (cash)	37 7 6
„ (three months)	36 5 0
MANCHESTER—	
Copper, Best Selected Ingots	67 10 0
„ Electrolytic	69 5 0
„ Strong Sheets	97 0 0
„ Tubes (Basis price)	0 1 1½
Brass Tubes (Basis price)	0 1 0½
„ Condenser	0 1 2½
Lead, English	37 10 0
„ Foreign	36 0 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/9 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	10/6
„ 6 p.c. to 8 p.c. „	£22 10 0	8/-
„ 8 p.c. to 10 p.c. „	£22 0 0	8/-
„ Specially Refined		
„ Max. 2 p.c. carbon	£45 0 0	18/-
„ „ 1 p.c. „	£56 0 0	21/-
„ „ 0.75 p.c. carbon	£68 0 0	22/6
„ carbon free	1/6 per lb.	
Metallic Chromium	4/- per lb.	
Ferro Manganese (per ton)	£17 for home, £17 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 5 0 scale 5/- per unit	
„ „ 75 p.c.	£18 10 0 scale 6/- per unit	
„ Vanadium	20/- per lb.	
„ Molybdenum	8/6 per lb.	
„ Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£130	
Cobalt	11/- per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	25/-
„ „ Ell	26/-
„ „ Splint	27/- to 28/6
„ „ Trebles	26/3
„ „ Doubles	24/6
„ „ Singles	22/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	25/-
„ „ Splint	26/6
„ „ Trebles	26/3
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	22/6 to 25/-
Screened Navigation	29/-
Trebles	27/6
Doubles	25/-
Singles	22/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	24/6
Secondary Steam	23/6
Trebles	27/-
Doubles	24/6
Singles	21/9

ENGLAND.

(8) N.W. COAST—	
Steams	31/-
Household	49/- to 59/-
Coke	41/-
NORTHUMBERLAND—	
Best Steams	25/6 to 26/-
Second Steams	24/- to 24/6
Steam Smalls	16/- to 16/6
Unscreened	22/6 to 23/6
Household	26/- to 28/-
DURHAM—	
Best Gas	25/-
Second	23/6 to 24/-
Household	26/- to 28/-
Foundry Coke	27/6 to 30/-

SHEFFIELD—	Inland.	
Best Hand-picked Branch	35/- to 36/-	—
Barnsley Best Silkstone	30/6 to 32/-	—
Derbyshire Best Brights	30/- to 32/-	—
„ „ House	26/- to 27/-	—
„ „ Large Nuts	24/6 to 25/6	—
„ „ Small „	18/6 to 20/6	—
Yorkshire Hards	25/- to 27/-	—
Derbyshire „	24/- to 25/-	—
Rough Slacks	12/6 to 13/6	—
Nutty „	10/- to 13/-	—
Smalls	7/6 to 9/6	—
Blast-furnace Coke (Inland)	27/- to 29/-	
„ „ (Export)	f.o.b.	35/- to 36/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	29/- to 30/-
Second „ „	28/- to 29/-
Best Dry Large	28/6 to 29/-
Ordinary Dry Large	27/- to 28/-
Best Black Vein Large	28/- to 29/-
Western Valley „	27/6 to 28/6
Best Eastern Valley Large	27/- to 28/-
Ordinary „ „	26/- to 27/-
Best Steam Smalls	19/- to 20/-
Ordinary „	17/- to 19/-
Washed Nuts	28/- to 30/-
No. 3 Rhondda Large	29/- to 30/-
„ „ Smalls	25/- to 26/-
No. 2 „ Large	24/- to 25/-
„ „ Through	21/- to 23/-
„ „ Smalls	19/- to 20/-
Coke (export)	52/6 to 57/6
Patent Fuel	30/- to 32/6
Pitwood (ex ship)	32/- to 33/-
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	40/- to 42/6
Seconds	32/6 to 35/-
Red Vein	30/- to 31/-
Machine-made Cobbles	47/6 to 52/6
Nuts	50/- to 55/-
Beans	46/- to 47/6
Peas	26/- to 27/-
Breaker Duff	12/9 to 13/3
Rubbly Culm	14/- to 14/6
Steam Coals:	
Large	24/6 to 25/-
Seconds	22/- to 23/-
Smalls	14/- to 16/-
Cargo Through	19/- to 21/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

† Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Capital and Industry.

THE measures being adopted by the Government to strengthen national finances and arrest the fall in the value of the franc are having the effect of seriously retarding industrial activity. As everyone regards the sacrifices as a national duty, the new burdens are accepted without protest, so long as they weigh upon all alike; but, unfortunately, the immediate result of the higher taxation and the depreciation of currency has been to divert capital from all industrial enterprise. The experience of four years ago is now being repeated, and many manufacturers are finding themselves in financial difficulties through the cessation of credits, while the list of failures of the smaller concerns is steadily increasing and is causing a feeling of insecurity in trade. When everything is rising in price, and the factor of production costs is becoming an unknown quantity, capital holds aloof, and is finding much more remunerative employment in financial transactions. At the same time, there is a retrenchment of expenditure all round. The Minister of Public Works has recommended the railway companies to delay giving out orders for the large quantities of rolling stock which they were on the point of purchasing. This has given rise to serious disappointment amongst wagon builders, who were beginning to recover from the long period of inactivity which has been hanging over the industry, and it is feared that the Minister's instructions will throw the trade back indefinitely. Elsewhere the effects of the policy of retrenchment are observable in the suspension of contracts for public works. It is hardly possible that this can continue without disturbing the industrial situation throughout the country. Matters are already sufficiently complicated by the labour agitation for higher wages, which is being strongly resisted, and a large motor car factory has been closed during the past two weeks for that reason. The energetic measures for arresting the fall of the franc were generally approved of before their effects upon the industrial and economic situation became so pronounced; but as they are accompanied by an all-round inflation it is argued that a more gradual imposition of charges would have been advisable.

Export Trade.

The various associations interested in the development of the export trade have held meetings during the week to discuss the situation arising out of the proposal to increase the import duties and prohibit the importation and exportation of certain classes of goods, and as the country's production has developed so considerably that anything which may restrict foreign markets will have disastrous reults for the engineering and other trades, the associations of manufacturers and traders are trying to bring home to the Government the necessity of doing nothing to check commercial relations with foreign countries. The fact that the trade returns for January show that the steady improvement which was observable all through last year has been arrested, is a factor tending to strengthen the arguments of those who maintain that any attempt to close this country to foreign goods must have the effect of restricting the sales of French manufactures and products abroad. With the heavier charges that are to be imposed on industry, manufacturers cannot afford to lose their foreign customers, and, while temporarily favoured by the exchange rate, they can continue to do business abroad if other countries are not tempted to make reprisals, as is being done in certain cases. So far as the engineering trades are concerned, there is very little being done on foreign account, although a few important contracts are obtained now and then, notably a heavy lot of cast iron pipes for South America; but the efforts to secure business by financing some of the smaller States for the carrying out of public works have not given encouraging results. The commercial community is well aware that there can be no consistent revival of trade unless foreign markets are encouraged to do business with this country, and it is feared that this will not be accomplished by means of the restrictions which the Government proposes to inflict upon trade by its system of prohibitions.

A Novel Concrete Bridge.

By far the longest ferro-concrete bridge in France is one which it is proposed to erect across the mouth of the river Elorn between Brest and Plougastel, where it will have a total length of more than 800 m. Built with three spans, the distance between the centres of the two piers will be 190 m., and the central arch will be 30 m. above high-water level. The piers will consist of caissons of ferro-concrete, 22 m. by 11.50 m., and will have their foundations on granite. The arches are hollow, the rectangular section having a width of 9.50 m. and a depth varying from 4.30 m. at the keystone to 9 m. at the springing. Each is divided into three compartments by two vertical webs, the upper compartment leaving a passage for the lower part of a box girder, which constitutes the railway track, while the top of the girder supports the roadway for vehicular and passenger traffic.

A Cable Ship.

There have been several examples of late of French shipyards securing contracts in competition with British and other shipbuilders, as the result, largely, of the comparatively lower wages and of the advantages offered to French shipbuilders to enable them to quote special prices for foreign orders. So great are the efforts being made to secure foreign contracts for shipyards that are almost destitute of work, that the competition is bound to become more pronounced in the future. During the past week the Chantier et Ateliers de Saint-Nazaire-Penhoet launched a cable ship—the Cyrus Field—for the Western Union Telegraph Company. The vessel has a length of 64.30 m., a width of 10.36 m., and a displacement of 3155 tons, and is fitted with engines developing 1200 horse-power.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

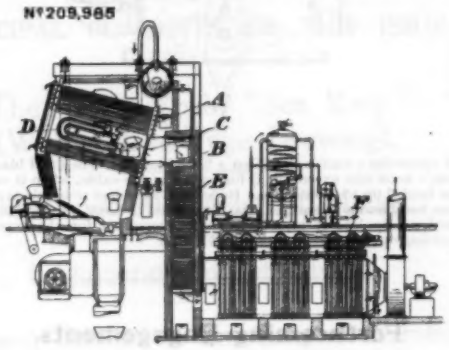
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

209,985. March 9th, 1923.—WATER-TUBE BOILERS, *Babcock and Wilcox, Limited*, 30, *Farringdon-street, London, E.C.*

This specification includes some extensive claims, the principal one among which appears to be the separation of the water tubes into two groups with separate headers A and B, con-

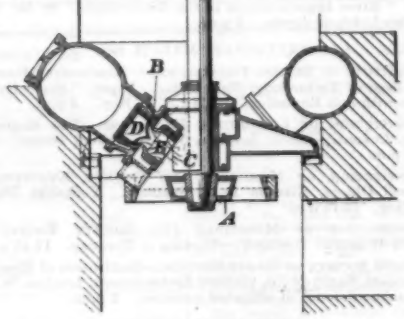


nected together by long nipples C. In the space between the two groups of tubes there is arranged a superheater D. Baffles are provided for deflecting the furnace gases over the heating surfaces. There are also a high-pressure economiser E and low-pressure economiser F.—*January 24th*, 1924.

TURBINE MACHINERY.

209,989. March 13th, 1923.—HYDRAULIC IMPULSE TURBINES, L. F. Moody, 408, W. Chelten-avenue, Germantown, Pennsylvania.

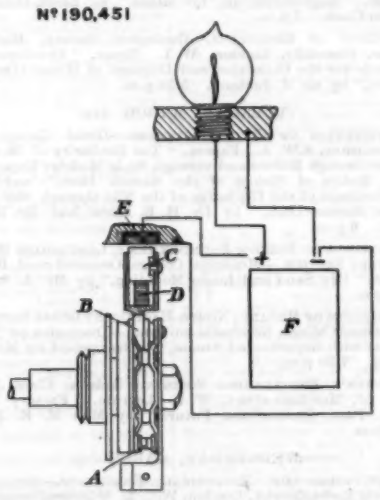
In this turbine an effort is made to get a high specific speed with a low head. The wheel A is mounted on a vertical shaft, and on it there are directed several jets from above. It is emphasised in the specification that the size of the jets may be large in comparison with the diameter of the wheel, while the



angle between the jet and wheel may be great. The orifices for the jets as annular openings B, which deliver the water radially inward. The water is then deflected to form the solid cylindrical jet C. The size of the jet is regulated by moving the plunger D under the influence of the governor, while part of the jet is deflected, in the case of sudden variation of the load, by the part E. The deflected water then goes to the tail race without acting on the wheel.—*January 24th*, 1924.

DYNAMOS AND MOTORS.

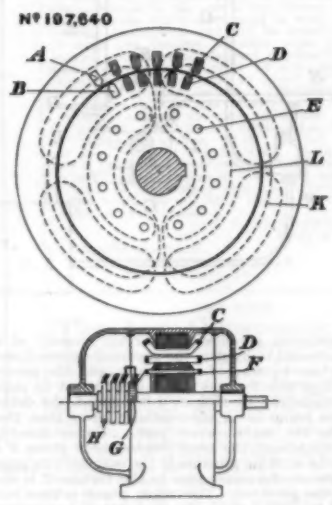
190,451. December 19th, 1921.—IMPROVEMENTS IN MAGNETO-ELECTRIC IGNITION AND LIGHTING APPARATUS, *Gustav Unterberg, of No. 2, Schlösselweg, Durlach* 1, *Baden, Germany.*



This invention relates to improvements in magneto-electric ignition and lighting apparatus for motor cars, and has for its object to provide an improved arrangement to enable a magneto of ordinary construction to be used for supplying direct current for lighting and other purposes, as well as for supplying the ignition currents. As long as the speed of the armature of the magneto exceeds a predetermined value, a contact block moves outwards against the action of a spring and makes intermittent contact with a fixed contact connected to the direct-current circuit, so that an intermittent direct current at a voltage higher than that of the accumulators is delivered to the direct-current circuit. The contact-breaking pieces of the primary circuit are shown at A, and B is the insulated part. This insulated part B serves as a support for the contact block C. E is the contact for collecting rectified current impulses and for transferring them to the secondary battery F. As soon as the contact breaker is rotated by its shaft, the contact block C on the support D moves radially in an outward direction against the action of the spring D. Rectified current impulses will, therefore, be collected from the magneto generator only when the number of revolutions is sufficiently high. If this number of revolutions of the magneto-electric generator for ignition current sinks below a determined value, the spring D pulls the contact block C back, and thus disconnects the secondary battery from the generator.—*January 21st*, 1924.

197,640. December 14th, 1922.—IMPROVEMENTS IN OR RELATING TO ASYNCHRONOUS INDUCTION MACHINES WITH COMPENSATION OF THE PHASE DISPLACEMENT, Dr. Tivadar Torda, now of V. Vilmos császár-út 78, Budapest, Hungary.

This specification describes an asynchronous induction motor having, in addition to the normal polyphase rotor winding, a phase compensating winding connected to a commutator, the two windings being wound for different numbers of poles and arranged so as substantially to prevent mutual induction between them. The slots A and B in the stator and rotor respectively, adjacent to the air gap, contain the usual primary winding C and secondary winding D of the induction motor. Within the circle or row of slots B of the normal polyphase rotor winding D there is a row of holes E which contain the winding F for

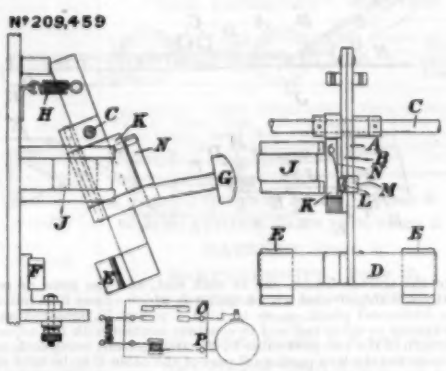


compensation of the phase displacement. The compensating winding F is connected to a commutator G, which is arranged between the slip rings H and the armature, but may be placed on the opposite side of the armature. Only a part K of the flux generated by the compensating winding F flows through the stator iron, while the remainder L of the flux completes its circuit within the rotor iron in which the magnetisation can approach nearer the saturation point than it can in the stator iron. In consequence of this arrangement, not only is the stator relieved from a part of the flux generated by the compensating winding F of the rotor, but the coupling of the fields generated by the windings C, D and F is looser than if the compensating winding F were placed on the same radius as the winding D.—*January 24th*, 1924.

ELECTRICAL APPLIANCES.

209,459. September 13th, 1922.—ELECTRIC SWITCHES FOR USE IN THE MAGNETISATION OF PERMANENT MAGNETS, The Stentophone Motor Accessories (1921), Limited, Ombersley-road, Camp Hill, Birmingham, and Austin Hamilton Treloggan, of 310, Alcester-road, Moseley, Birmingham.

This invention consists of a switching arrangement designed to send a large current of short duration through the winding of an electro-magnet used for magnetising, and is particularly adapted for magnetising the magnets of a Ford magneto. The winding can be of low resistance and the current density greatly



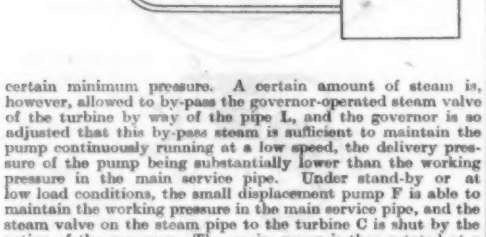
in excess of the normal. The action is such that on closing the switch the current passes through the winding of an electro-magnet in series with the external circuit; and this electro-magnet trips the switch and opens the circuit. With suitable strength of springs the switch will allow a large current to flow for a very short period. The arms A and B are free on the spindle C. The arm A carries an insulated arm D having contact blocks E, which make contact with the fixed blocks F on pressing switch knob G. Both arms are held in the open position by the springs H. On closing the switch the current energises the electro-magnet J, and attracts the armature K. The arm A is then released by the catch L and M, and the armature K is returned

by the spring N. The catch re-engages when the arm B is allowed to rise. The lower diagram shows the connections for magnetising the magnets of a Ford car magneto without removing them from the engine. The terminal O is connected to the magneto terminal and P to the car frame. The magneto is first set—by means of a magnetic compass placed on the transmission case—so that the magnets are in the correct position relative to the wound stator. On operating the magnetiser, one or more impulses as designed are sent through the stator winding, which then acts as an electro-magnet and magnetises the magnets.—*January 14th*, 1924.

MISCELLANEOUS.

209,624. February 28th, 1923.—IMPROVEMENTS IN AND RELATING TO HYDRAULIC INSTALLATIONS, G. and J. Weir, Limited, of Holm Foundry, Cathcart, Glasgow, and James George Weir.

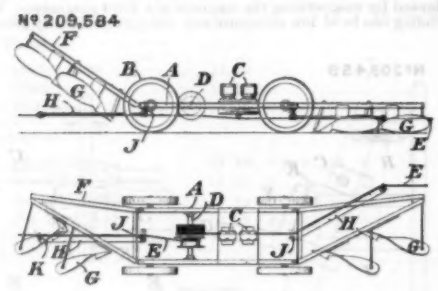
This specification describes improved means for supplying and maintaining fluid at a desired pressure in a main service pipe, where the use of an accumulator is inadmissible. A is the main service pipe. B is the main pump, of the centrifugal type, and driven by the steam turbine C. It delivers into the main service pipe through the non-return valve D, and the pipe E. F is the auxiliary displacement pump, driven by steam, and it discharges into the main service pipe by way of the pipe G. H is the pipe which supplies steam for driving the two pumps. J is a tank from which the two pumps draw their fluid. A pressure-operated governor K is arranged on the steam supply pipe H in such a manner that steam is shut off from the turbine C so long as the pressure in the main service pipe exceeds a



certain minimum pressure. A certain amount of steam is, however, allowed to by-pass the governor-operated steam valve of the turbine by way of the pipe L, and the governor is so adjusted that this by-pass steam is sufficient to maintain the pump continuously running at a low speed, the delivery pressure of the pump being substantially lower than the working pressure in the main service pipe. Under stand-by or at low load conditions, the small displacement pump F is able to maintain the working pressure in the main service pipe, and the steam valve on the steam pipe to the turbine C is shut by the action of the governor. The main pump is then rotated at a low speed by means of the by-pass steam, and is, accordingly, not consuming the large amount of power which it would require were it running to maintain the full pressure. Immediately a demand is made on the main service pipe for more fluid than the displacement pump can supply, the pressure falls in the pipe, and the main pump is given full steam by the governor and comes into useful operation.—*January 17th*, 1924.

209,584. December 12th, 1922.—IMPROVEMENTS IN OR RELATING TO MOTOR PLOUGHS WORKING ON THE FIXED CABLE SYSTEM, James Robinson and Percy Robinson, both of 65, Hill Top-mount, Roundhay-road, Leeds.

This invention relates to that type of motor plough which is adapted to haul itself along a cable anchored at the headlands, and in which one length of the cable is wound in upon a drum, while the other length is payed off from a second drum during each bout, the tractor frame being mounted on running and steering wheels and carrying two sets of plough shares placed at opposite ends and adapted to be alternately lowered into and raised out of the operative position, the object being to provide motor ploughs of the type specified with means whereby the slack or paying off rope may be held clear of the plough shares in work. The tractor frame A is mounted on running wheels B, and carries an internal combustion engine C adapted to drive the main shafts D which carries the winding drums, which in turn carry the two-part cable E. F indicates the plough share frame fitted with plough shares G. Two arms or poles H are pivoted



to the tractor frame, one at each end, and the arms or poles H are each provided with a spring J, which causes it to move in a horizontal plane, so as to hold a pulley K, situated at its extreme or outer end and in constant contact with the adjacent length of the two-part cable E, the arrangement being such as to cause the slack or paying-off part of the cable E to be held clear of the set of plough shares G at work. Assuming the tractor to be travelling forward, the pull on the taut or winding-in part of the cable E is sufficient to overcome the spring J, and render the pulley arm H inoperative for the time being, while simultaneously the other or rear pulley arm or pole H, through the medium of its spring J, holds the slack or paying-off part of the cable E clear of the working plough shares G. At the end of the forward travel, and on the tension of the winding-in part of the cable E having been relaxed, the leading pulley arm or pole H comes into action and moves the slack winding-in part of the cable E to one side of the implement, when the positions of the plough shares G are reversed and the implement started on its return bout, which has the effect of rendering the leading pulley arm or pole H inoperative.—*January 17th*, 1924.

209,905. November 29th, 1922.—A CABLE CUTTER, F. A. Bullivant, 72, Mark-lane, London, and G. M. Selby, West Ferry-road, Millwall.

This apparatus is intended for cutting wire rope cables more readily than is possible than when divers have to descend into the water to do the work. It takes the form of a hydraulic ram

A operating a cutter B against a fixed blade C. The fixed blade has a hook-like extension D for engaging the cable, when it can be hauled up to the surface. Ropes E E attached to brackets on the body and a messenger rope F are used to hoist the appliance and manipulate it into a convenient position for the actual cutting operation.—*January 24th*, 1924.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecturette, "The Manufacture of the Incandescent Electric Lamp," by Mr. W. A. Rhind. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Modern Navigational Devices," by Mr. F. E. Smith. 9 p.m.

UNIVERSITY OF LONDON.—Institution of Civil Engineers, Great George-street, London, S.W. 1. "Practical Hydraulic Engineering Problems in Connection with Navigation." Lecture III.: "River Improvements in the Netherlands," by Mr. O. C. A. Van Lidth de Jeude. 5 p.m.

SATURDAY, MARCH 1ST.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—College of Technology, Manchester. Paper, "Some Experiences with Jolt Ramming," by Mr. A. L. Key. 4 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—The Engineers Club, Coventry-street, London, W. 1. Annual dinner. 6.30 for 7 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Council Offices, Kiveton Park, Sheffield. Yorkshire District meeting. 12.15 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS: SOUTH-WESTERN DISTRICT.—Meeting at Torquay. 11.45 a.m.

RADIO SOCIETY OF GREAT BRITAIN.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Annual conference of affiliated societies. 2 p.m.

MONDAY, MARCH 3RD.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. Discussion on "Modern Developments in Electric Driving of Textile Mills," introduced by Mr. J. W. Longley. 7.30 p.m.

INSTITUTE OF TRANSPORT.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Paper, "Air Transport and Its Uses," by Mr. G. Holt Thomas. 5.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: NEWCASTLE-UPON-TYNE ASSOCIATION.—Lecture Theatre, Neville Hall, Newcastle-on-Tyne. Paper, "Reinforced Concrete, Reservoirs and Water Towers," by Mr. T. H. Bryce. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Graduates' Section. Annual lecture, "Engineering in Literature," by Lieut.-Colonel E. Kitson Clark. 7 p.m.

SOCIETY OF ENGINEERS.—Geological Society, Burlington House, Piccadilly, London, W. 1. Paper, "Development of Methods for the Collection and Disposal of House (Domestic) Refuse," by Mr. J. Jackson. 5.30 p.m.

TUESDAY, MARCH 4TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Papers, "The Similarity of Motion of Water through Sluices and through Scale Models: Experiments with Models of Sluices of the Assuan Dam," and "The Measurement of the Discharge of the Nile through the Sluices of the Assuan Dam," by Dr. H. E. Hurst and Mr. D. A. F. Watt. 6 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—Municipal College, Ormerod-road, Burnley. Paper, "Dry Sand and Loam Moulding," by Mr. A. Sutcliffe. 7.15 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Armstrong College, Newcastle-on-Tyne.—Discussion on "Alloys for use with Superheated Steam," to be opened by Mr. H. J. Young. 7.30 p.m.

WOMEN'S ENGINEERING SOCIETY.—Samson Clark Lecture Hall, 57, Mortimer-street, W. 1. Lecture, "Factory Legislation: Past, Present and Future," by Miss M. E. Phillips. 6.30 p.m.

WEDNESDAY, MARCH 5TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. "Development of the Bellini-Tosi System of Direction-finding in the British Mercantile Marine," by Commander J. A. Slee, R.N. 6 p.m.

INSTITUTION OF ENGINEERING INSPECTION.—Hotel Cecil, Strand, London, W.C. 2. Annual dinner. 7 for 7.30 p.m.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—The Engineers' Club, Coventry-street, London, W. 1. Discussion on "Heating and Ventilation as Applied to Ferro-concrete Buildings," introduced by Mr. A. A. H. Scott. 7 p.m.

INSTITUTION OF SANITARY ENGINEERS.—Caxton Hall, Westminster, London, S.W. 1. Paper, "The Water Supply of Rural Districts," by Mr. C. H. Roberts. 7.30 p.m.

NEWCOMEN SOCIETY.—Prince Henry's Room, 17, Fleet-street, London, E.C. 4. Papers, "The Rastricks: Civil Engineers," by Messrs. H. W. Dickinson and A. Lee; "Memorandum on the Four Locomotives of the Delaware and Hudson Company, 1829," by Mr. L. F. Loree. 5.30 p.m.

THURSDAY, MARCH 6TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. "Transmission Maintenance of Telephone Systems," by Messrs. P. E. Erikson and R. A. Mack. 6 p.m.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Sound Reception," by Major Tucker. 5.30 p.m.

FRIDAY, MARCH 7TH.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—The University, St. George's-square, Sheffield. Paper, "Some Aspects of Alloy Plating," by Mr. S. Field. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, London, S.W. 1. Informal meeting. Lecture, "Recovering Gold from the Laurentic," by Commander G. C. C. Damant, R.N. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecturette, "An Introduction to the Study of Fire Danger in Factories, with some Notes on Fire Insurance," by Mr. P. M. Fraser.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "The Inner Structure of Alloys," by Dr. W. Rosenhain, F.R.S. 9 p.m.

SATURDAY, MARCH 8TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "Properties of Gases in High and Low Vacua," Lecture I., by Sir Ernest Rutherford, F.R.S. 3 p.m.

MONDAY, MARCH 10TH.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Annual general meeting. "The Romance of Aluminium," by Mr. G. B. Brook. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Informal meeting. A discussion on the work of the International Conference on E.H.T. Lines, held in Paris in November last, will be opened by Monsieur J. Tribot Laspière. 7 p.m.

TUESDAY, MARCH 11TH.

INSTITUTE OF MARINE ENGINEERS.—85-88, The Minories, London, E. 1. "A Note on the Air Supply to the Larger Type of Motor Vessel," by Captain P. T. Brown. 6.30 p.m.

WEDNESDAY, MARCH 12TH.

INSTITUTE OF METALS.—The Trocadero, Piccadilly-circus, London, W. 1. Annual dinner. 7.15 for 7.30 p.m.

WEDNESDAY AND THURSDAY, MARCH 12TH AND 13TH.

INSTITUTE OF METALS.—Institution of Mechanical Engineers, Storey's-gate, London, S.W. 1. Annual general meeting. 10 a.m. each day. For programme see page 208.

FRIDAY, MARCH 14TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, Westminster, S.W. 1. Paper, "Water-tube Boilers," by Mr. L. M. Jockel. 7.30 p.m.

SATURDAY, MARCH 15TH.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—Metallurgical Department, University College, Singleton Park, Swansea. General Discussion. 7.15 p.m.

SATURDAY TO SATURDAY, MARCH 15TH TO 22ND.

MARINE AND SMALL CRAFT EXHIBITION at the Royal Agricultural Hall, Islington, London, N. 1.

MONDAY, MARCH 17TH.

INSTITUTION OF STRUCTURAL ENGINEERS.—Criterion Restaurant, London, W. 1. Annual dinner. 7 for 7.30 p.m.

UNIVERSITY OF LONDON.—Institution of Civil Engineers, Great George-street, London, S.W. 1. "Practical Hydraulic Engineering Problems in Connection with Navigation." Lecture IV.: "Harbour Engineering Abroad," by Mr. O. C. A. Van Lidth de Jeude. 5 p.m.

TUESDAY, MARCH 18TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Chamber of Commerce, New-street, Birmingham. Paper, "Brittle Ranges in the Brasses," by Mr. D. Bunting. 7 p.m.

WEDNESDAY, MARCH 19TH.

UNIVERSITY OF LONDON.—Institution of Civil Engineers, Great George-street, London, S.W. 1. "Practical Hydraulic Engineering Problems in Connection with Navigation." Lecture V.: "Shipping Conditions in Port," by Mr. O. C. A. Van Lidth de Jeude. 5 p.m.

THURSDAY, MARCH 20TH.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Institute of Marine Engineers, 85-88, The Minories, London, E. 1. Open discussion. 8 p.m.

FRIDAY, MARCH 21ST.

EX-BRITISH WESTINGHOUSE ASSOCIATION.—Holborn Restaurant, London, W.C. 1. Sixth annual re-union dinner. 5.45 for 6.45 p.m.

UNIVERSITY OF LONDON.—Institution of Civil Engineers, Great George-street, London, S.W. 1. "Practical Hydraulic Engineering Problems in Connection with Navigation." Lecture VI.: "The Zuiderzee Scheme," by Mr. O. C. A. Van Lidth de Jeude. 5 p.m.

THURSDAY, MARCH 27TH.

ROYAL AERONAUTICAL SOCIETY.—7, Albemarle-street, London, W. 1. Annual general meeting. 5 p.m.

WEDNESDAY, APRIL 9TH.

INSTITUTION OF NAVAL ARCHITECTS.—Connaught Rooms, Great Queen-street, London, W.C. Annual dinner. 7.30 p.m.

WEDNESDAY TO FRIDAY, APRIL 9TH TO 11TH.

INSTITUTION OF NAVAL ARCHITECTS.—Royal United Service Institution, Whitehall, London, W.C. 2. Annual general meetings.